January, 1970
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GENERAL RADIO COMPANY
WEST CONCORD • MASSACHUSETTS, 01781

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617 646-7400 (Boston)
TWX 710 347-1051

DRAWING INDEX

TYPE 2990-9174

AUTOMATIC CAPACITOR TESTING SYSTEM

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Form 2990-9174
January, 1970
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OPERATING INSTRUCTIONS

TYPE 2990-9174

AUTOMATIC CAPACITOR-TESTING SYSTEM

1.1 INTRODUCTION.

Figure 1 and Drawing 2990-9174-1D show the Type 2990-9174 Automatic Capacitor-Testing System with the front panel doors open. Figure 2 is a front-panel view with the system in the normal operating configuration (doors closed). The system is a computer controlled measurement system for automatically measuring the capacitance, dissipation factor and leakage current of up to 100 components. Leakage measurements can be made from 0 to 600 V in 1-V steps and capacitance/dissipation-factor measurements under bias voltages from 0.0 to 50.0 V in 0.1-V increments. Single components can be measured using the Type 2995-9243 Test Fixture.

2.1 COMPONENTS.

The system contains the following basic components:

Name	G. R. Part No.	Description
Power Control	2995-3085	See Instruction Sheet
Variac® Automatic Voltage Regulator	1591-9712	Manual Enclosed
Interface	1761-9000	See Instruction Sheet
Digital Voltmeter	1820-9008	See Instruction Sheet
Leakage Range Plug-in Unit	1820-9007	See Instruction Sheet
Display Unit	2995-9201	See Instruction Sheet
Computer	2995-9200	See Instruction Sheet
Scanner Control	2995-9202	See Instruction Sheet
Scanner Switch	1772-9028	See Instruction Sheet
Scanner Switch	1772-9029	See Instruction Sheet
Scanner Switch	1772-9030	See Instruction Sheet
Power Supply	2995-9264	See Instruction Sheet
Power Supply	2995-9199	See Instruction Sheet
Programmable Decade	2995-9198	See Instruction Sheet
Bias Supply	2995-9282	See Instruction Sheet
Automatic Capacitance Bridge	1680-9001	See Instruction Sheet
Test Fixture	2995-9197	See Instruction Sheet
Test Fixture	2995-9243	See Instruction Sheet
Test Socket Panel	2995-3084	See Instruction Sheet
Teleprinter	2995-9204	See Instruction Sheet

Other items are provided as listed on Drawings 2990-9174-0L, 1L, 2L and 3 L.

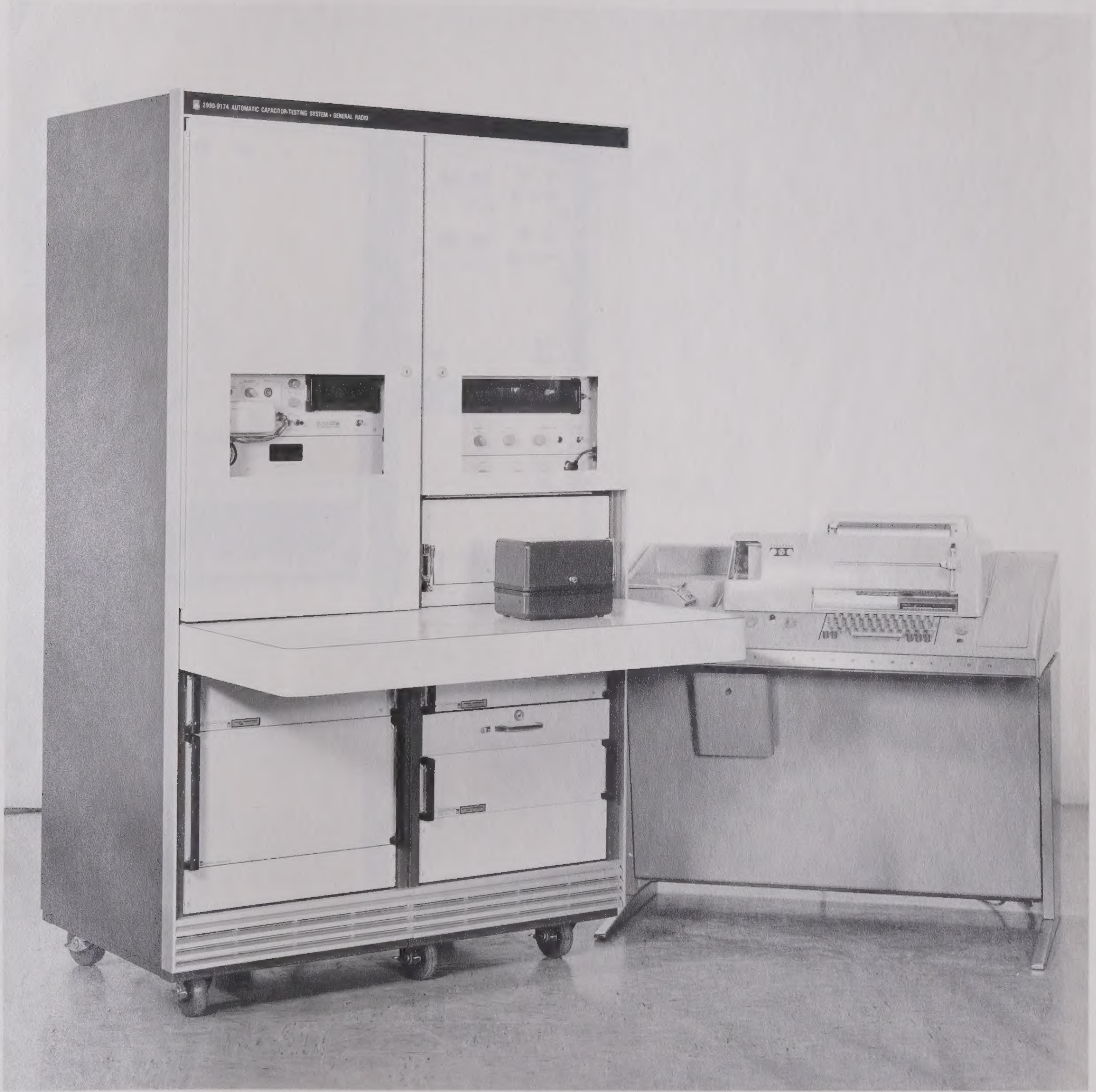
2900-9174 AUTOMATIC CAPACITOR-TESTING SYSTEM • GENERAL RADIO

FIGURE 2

#6

2990-9174
11,121

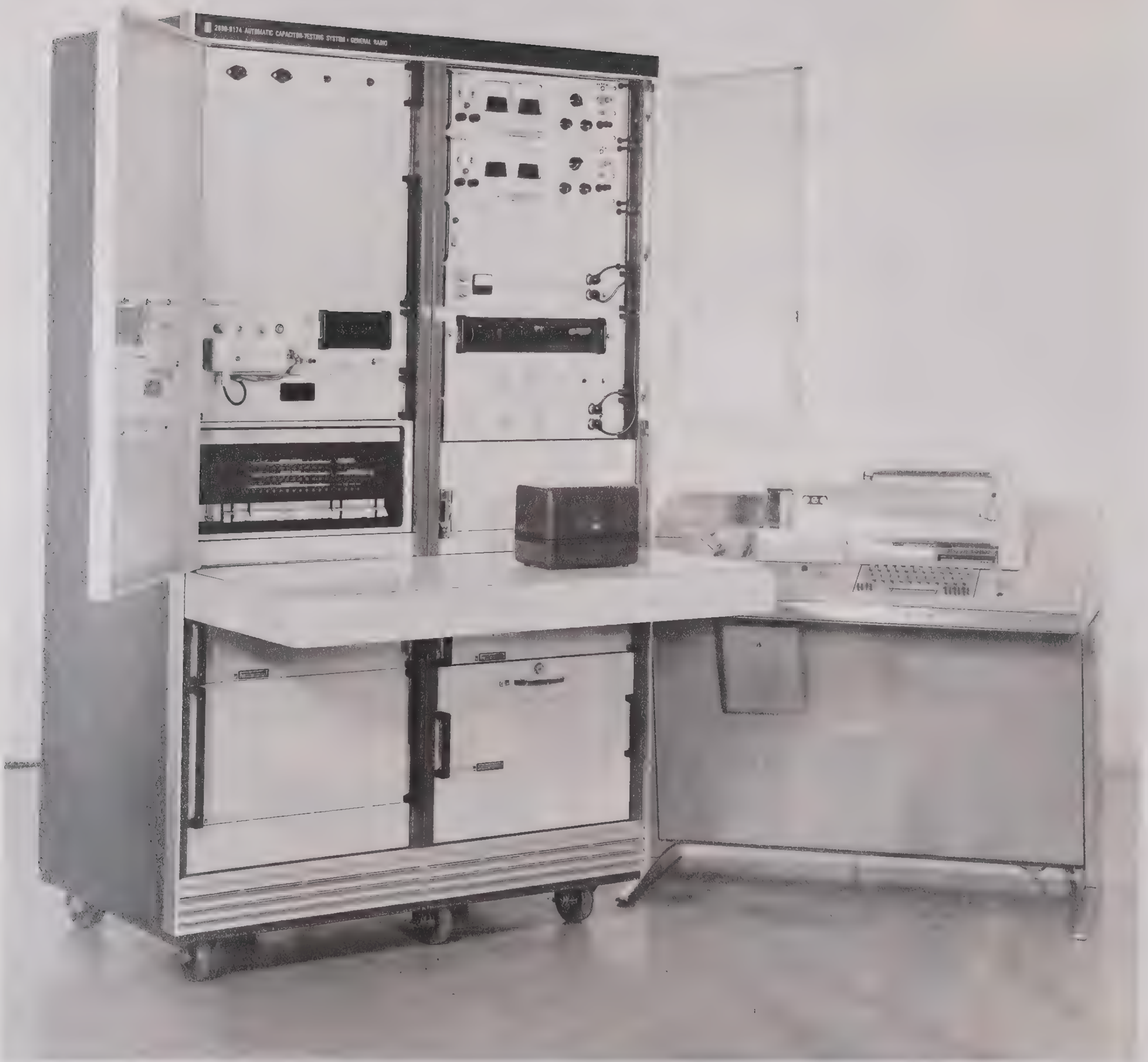
2800-9174 AUTOMATIC CAPACITOR-TESTING SYSTEM • GENERAL RADIO

FIGURE 1

2990-9174

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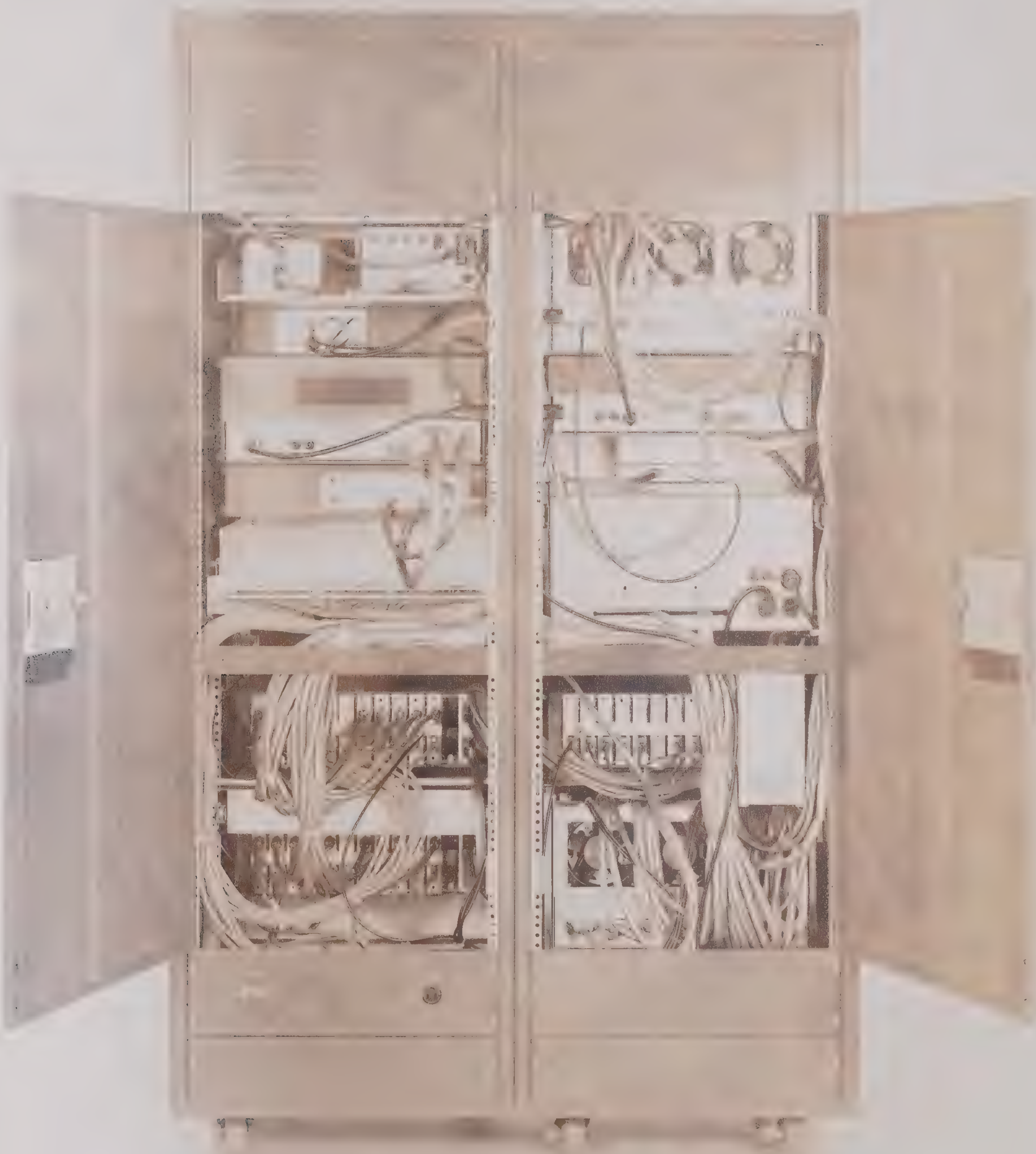

Figure 2

2240 9174 # 1122 1-12-70 7

PARTS LIST

SHEET .... OF ....

INSTRUMENT 2990-9174 AUTOMATIC CAPACITANCE TESTING SYSTEM

NAME OF PART	DWG. NO.	PART NO.	DRAFTING NO.	REQ.
AUTO. CAP. TESTING [illegible]		[illegible]		
[illegible]	[illegible]	[illegible]		[illegible]
[illegible]		[illegible]		
		[illegible]		
[illegible]		[illegible]		
[illegible]		[illegible]		
[illegible]			[illegible]	

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PARTS LIST

SHEET 1 OF 3

INSTRUMENT 2990-9174 AUTOMATIC CAPACITANCE TESTING SYSTEM

	NAME OF PART	DWG. NO.	PART NO.		DRAFTING NO.	REQ.	
1							1
2	[illegible]	[illegible]	[illegible]	[illegible]			2
3							3
4	[illegible]	[illegible]	[illegible]	[illegible]		1	4
5							5
6	[illegible]		[illegible]	[illegible]		1	6
7	[illegible]		1761	9000		1	7
8	Digital Voltmeter		[illegible]	[illegible]		1	8
9	[illegible] Millivoltmeter		[illegible]	9001		1	9
10	Leakage Range Module		[illegible]	[illegible]		1	10
11	Voltage Regulator		[illegible]	[illegible]		1	11
12	Display Unit		[illegible]	9201		1	12
13							13
14	PDP-8L Computer		[illegible]	9200		1	14
15	Line Filter		2995	[illegible]		1	15
16	Scanner Control		2995	[illegible]		1	16
17	Scanner Switch		1772	[illegible]		1	17
18							18
19	Power Supply/Kepco BHK 500-0.4(M)		2995	9264		1	19
20	Power Supply/Kepco BHK 1000-0.2(M)		[illegible]	[illegible]		1	20
21							21
22	[illegible] Decade		2992	[illegible]		1	22
23	High Voltage Relay Unit		[illegible]	[illegible]		1	23
24	[illegible] Supply		[illegible]	[illegible]		1	24
25	[illegible] Capacitance Bridge		[illegible]	[illegible]		1	25
26							26
27	[illegible] Fixture 0-100 Components		[illegible]	[illegible]		1	27
28	[illegible] Socket Panel		[illegible]	[illegible]		1	28
29							29
30	Scanner Switch		1772	9028		1	30
31	Scanner Switch		1772	[illegible]		1	31
32							32
33	[illegible]		2992	[illegible]		1	33
34							34
35	[illegible] Panel [illegible]		0480	[illegible]		1	35
36							36
37	[illegible] Panel [illegible]		[illegible]	[illegible]			37
38	[illegible] Panel		[illegible]	[illegible]		1	38
39	[illegible] Panel		2992	[illegible]		1	39
40							40
41	[illegible] Switch Module (For-[illegible])		[illegible]	[illegible]		[illegible]	41
42	[illegible] Switch Module (For-[illegible])		[illegible]	[illegible]		[illegible]	42
43							43
44							44
45							45

NUMBER

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DATE [illegible]

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NUMBER 2990-9174-[illegible]

ISSUE 3

PARTS LIST

SHEET [illegible] OF [illegible]

INSTRUMENT [illegible]

	NAME OF PART	DWG. NO.	PART NO.	DRAFTING NO.	REQ.	
1						1
2						2
3	[illegible]t Bracket		[illegible]			3
4						4
5	[illegible]		[illegible]		[illegible]	5
6	[illegible]		[illegible]		[illegible]	6
7	[illegible]	[illegible]	[illegible]		[illegible]	7
8						8
9	[illegible]		[illegible]		[illegible]	9
10	[illegible]		[illegible]		[illegible]	10
11	[illegible]	[illegible]	[illegible]		[illegible]	11
12						12
13	[illegible]		[illegible]		[illegible]	13
14						14
15	[illegible]		[illegible]		[illegible]	15
16	[illegible]		[illegible]		[illegible]	16
17						17
18	[illegible]		[illegible]		[illegible]	18
19						19
20	[illegible]		[illegible]		[illegible]	20
21	[illegible]		[illegible]		[illegible]	21
22	[illegible]		[illegible]		[illegible]	22
23	[illegible]		[illegible]		[illegible]	23
24	[illegible]		[illegible]		[illegible]	24
25						25
26	[illegible]	[illegible]	[illegible]		[illegible]	26
27	[illegible]		[illegible]		[illegible]	27
28						28
29	[illegible]		[illegible]		[illegible]	29
30						30
31	[illegible]		[illegible]		[illegible]	31
32						32
33	[illegible]		[illegible]		[illegible]	33
34	[illegible]		[illegible]		[illegible]	34
35						35
36	[illegible]		[illegible]		[illegible]	36
37	[illegible]		[illegible]		[illegible]	37
38						38
39	[illegible]		[illegible]		[illegible]	39
40						40
41	[illegible]	[illegible]	[illegible]		[illegible]	41
42	[illegible]		[illegible]		[illegible]	42
43	[illegible]		[illegible]		[illegible]	43
44						44
45						45

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ISSUE [illegible]

PARTS LIST

SHEET 3 OF 3

INSTRUMENT 2990-9174 AUTOMATIC CAPACITANCE TESTING SYSTEM

NAME OF PART	DWG. NO.	PART NO.	DRAFTING NO.	REQ.
A				
Cable Asm. Y		2994 1111		[illegible]
Cable Asm. Z, BB	1114	2994 1115		[illegible]
Cable Asm. AA,EE,FF,GG	1114	2994 1118		4
Signal Cable CC		4205 1000		1
Cable DD		0776 9922		1
Cable Asm. MM		2994 1190		1
Cable Asm. NN		2994 1114		1
Terminal & Lead Asm. PP,SS	1180	2994 1182		2
Cable Asm. QQ		2994 1183		1
Cable RR		2994 1079		1
Patch Cord TT,VV		2994 1112		2
Cable Asm. UU		2994 1189		2
Calibration Cable Asm.		2994 1144		1
Test Cable Asm.		2995 1145		1
Screw		7270 6110		[illegible]
Open Circuit Termination		0874 9911		1*

* Attach to Rear 874 Connector on 1680 Bridge (External Standard)

NUMBER	2990-9174-3L/2
ISSUE	2
FILE	
DATE	11-18-69
ISSUE	1

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Fig. 6 1-19-70 EM

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3.1 CONNECTIONS.

3.1.1 Power.

The power is connected to the console through a ten foot cable at the top of the console. The cable has a Hubbell Type 3331 plug to mate with a Hubbell Type 3330 socket, 30A, 120 V.

3.1.2 Instruments.

The system requires 22 A at 120 V, 60 Hz. Drawing 2990-9174-2D shows cable inter-connections and Figure 3 is a rear-view photograph of the connected system.

3.1.3 Components Under Test.

The components (0 through 99) are first connected to a component test board and then installed in the 2995-9197 Test Fixture. Both the negative and positive terminals are individually connected to the system.

Single components can be connected to the 2995-9243 Test Fixture by opening up the protective box, placing the component between the test terminals, and closing the box.

4.1 OPERATION.

4.1.1 Initial Start.

The Type 2990-9174 Automatic Capacitor-Testing System should be prepared for operation as follows:

a.) Unlock and open the doors at the front of the system.
b.) Set the instrument controls as shown in Table 1.
c.) Turn the key control on the computer to POWER.
d.) Set the ON-OFF switch on the 1591 Regulator to ON. This will turn the entire system on.
e.) Load the main test tape and the /S overlay tape.
f.) Momentarily depress the LOAD ADDRESS and START switches (respectively, one at a time) on the computer. This will produce a feed of the teletype paper and produce a reading of 111 on the Display Unit. The system is now ready to receive the test data.

4.1.2 Test Data Entry.

Table 2 lists a summary of the keyboard commands.

a.) Type a /P command. The teletype will type PART NUMBER: and wait. Refer to Figure 4 for a typical printout.

b.) Type the desired part number on the teletype and depress the RETURN key. The teletype will type C NOM (PF, NF, UF): and wait.

c.) Type in the nominal value of capacitance and depress the RETURN key. The teletype will type C LIM (%, PF, NF, UF): and wait.

TABLE 1

CONTROL SETTINGS

Instrument	Control	Setting
Kepco Model BHK 500-0.4 (M) Power Supply	POWER, AC-OFF	AC
	POWER, DC-OFF	DC
	VOLTAGE SELECTOR	150-200
	VOLTAGE ADJUST	Set to 200V on D-C VOLTS meter
	CURRENT ADJUST	Maximum cw
Kepco Model BHK 1000-0.2 (M) Power Supply	POWER, AC-OFF	AC
	POWER, DC-OFF	DC
	VOLTAGE SELECTOR	(Disabled)
	VOLTAGE ADJUST	(Disabled)
	CURRENT ADJUST	Maximum cw
Kepco Model DPD-4 Programming Decade	ON-OFF	ON
Bias Supply	POWER-OFF	POWER
	All other controls	(Disabled)
Digital Control Unit	FREQUENCY	As desired
	BALANCE	AUTOMATIC RANGE
	MEASUREMENT RATE	MANUAL
	INTENSITY	As desired
	POWER, ON-OFF	ON
Automatic Capacitance Bridge	LOSS	CONDUCTANCE
	FREQUENCY	As desired
Digital Voltmeter	VOLTS	DC
	DC VOLTAGE	NORM
	INPUT FILTER	MIN
	SAMPLING RATE	Maximum cw
	FUNCTION	LINEAR
	RANGE	AUTO
	POWER	ON
Computer	MEM PROT	UP
	CAUTION The MEM PROT switch must be in the UP position to protect the program.	
	SWITCH REGISTER	2214
	SING STEP	Up
Teleprinter	ON LINE-OFF-OFFLINE	ON LINE
	P-S	S
	K-KT-T-TTS-TTR	KT

TABLE 2

KEYBOARD COMMANDS

Command	Function	Paragraph
/P	Enter initial test conditions	4.1.2
/V	Verify test conditions	4.1.3
/U	Punch test-condition tape	4.1.4
/R	Prepare for test	4.1.5
/S	Continue	4.1.5
/T	Test and punch output tape	4.1.5
/O	Repeat test	4.1.5
/W	Print Summary Report	4.1.7
/Q	Abort and form feed	4.1.8
/M	Manual	4.1.11

```
P

PART NUMBER:    TEST BOARD

C NOM (PF,NF,UF): 10NF

↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF

LO LIM (%,PF,NF,UF):  150PF

DF LIM: 1.0

↑DF LIM:  2%

BIAS TEST V:  1.0

FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA

↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  50

SOAK TIME (MIN:SEC):  10

FIRST POS:  0

LAST POS: 6

STEPS:  1
```

Figure 4. Data typed into system.

Underlined information was typed upon request.

d.) Type in the desired capacitance deviation (% or units, paragraph 4.1.9) between test two and test one values and depress the RETURN key. The teletype will type UP LIM (%, PF, NF, UF): and wait.

e.) Type in the desired upper limit of capacitance (C maximum) and depress the RETURN key. The teletype will type LO LIM (%, PF, NF, UF): and wait.

f.) Type in the desired lower limit of capacitance (C minimum) and depress the RETURN key. The teletype will type DF LIM: and wait.

g.) Type the desired dissipation factor limit and depress the RETURN key. The teletype will type ΔDF LIM: and wait.

h.) Type the desired dissipation-factor deviation (% or units) between test two and test one values and depress the RETURN key. The teletype will type BIAS TEST V: and wait.

i.) Type in the desired bias voltage between .0 and 50.0 and depress the RETURN key. The teletype will type FREQUENCY (KHZ, HZ): and wait.

j.) Type in the frequency value that the Digital Control Unit and the Automatic Capacitance Bridge were set to (in step b) and depress the RETURN key. The teletype will type IL LIM (NA, UA, MA): and wait.

k.) Type in the desired leakage-current limit and depress the RETURN key. The teletype will type ΔIL LIM (%, NA, UA, MA): and wait.

l.) Type in the desired leakage-current deviation (% or units) between test two and test one values and depress the RETURN key. The teletype will type LEAK TEST V: and wait.

m.) Type in the desired leakage test voltage (0-600 V) and depress the RETURN key. The teletype will type SOAK TIME (MIN: SEC): and wait.

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n.) Type in the desired soak time for the test (multiples of ten seconds). If a number is typed, the system will recognize it as the number of seconds. If a number followed by a colon and another number is typed, the system will recognize it as a number of minutes and seconds (MIN: SEC). Depress the RETURN key. The teletype will type FIRST POS: and wait.

o.) Type in the number of the first desired test position and depress the RETURN key. The teletype will type LAST POS: and wait.

p.) Type in the number of the last desired test position and depress the RETURN key. The teletype will type STEPS: and wait.

q.) Type in the desired interval between test positions (paragraph 4.1.10) and depress the RETURN key. The teletype will return to the left-hand margin and wait for another command.

4.1.3 Test Data Verification.

To verify the test data, type a /V. The information just typed into the system will be typed back for verification (Figure 5). After typing each line the system will pause and wait for a command. If the information on the line is correct, depress the RETURN key and the typing will continue. If the information on the line is incorrect, depress the RUBOUT key, type in the correct information and depress the RETURN key.

4.1.4 /U Punched Tape Production.

Type a /U (Figure 5) and the teletype will begin to produce a punched tape of the data just typed into the system (Figure 6). When the tape is complete, the teletype will give a form feed (one page) and wait for a new command. Mark the tape /U.

```
V
PART NUMBER:    TEST BOARD

C NOM (PF,NF,UF): 10NF

↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF

LO LIM (%,PF,NF,UF):  150PF

DF LIM: 1.0

↑DF LIM:  2%

BIAS TEST V:  1.0   1.5

FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA

↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  50   25

SOAK TIME (MIN:SEC):  10

FIRST POS:  0

LAST POS: 6

STEPS:  1

U
```

Figure 5. Verification of data.

Underlined information was typed upon request.

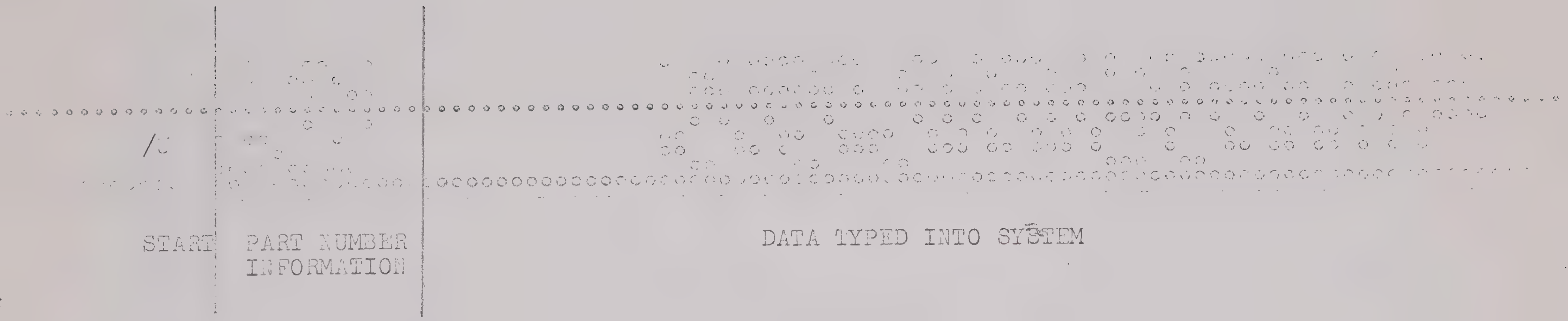

/U
START
PART NUMBER INFORMATION
DATA TYPED INTO SYSTEM

Figure 6. /U tape.

4.1.5 Test 1.

To make a test 1 measurement, proceed as follows:

a.) Load the tape just punched (/U tape) into the reader.

b.) Type a /R command into the teletype.

c.) Turn the reader on (RUN) and let the tape run through the part number information (Figure 6) before turning the reader off (STOP). The teletype will type the part number information (Figure 7). If the part number is correct for the measurements to be made, proceed with step d. If the part number is incorrect, refer to paragraph 4.1.8.

d.) Type a /S command on the teletype. The teletype will type out the information given to the system in a semi-paragraph form. The printout will stop after STEPS: 1, feed a few lines and type TEST NO: and wait.

e.) Type in the number 1 and depress the RETURN key. The teletype will type DATE: and wait.

f.) Type in the date and depress the RETURN key. The teletype will type T & IR NO: and wait.

g.) Type in the desired T and IR number and depress the RETURN key. The teletype will return to the left-hand column and wait for a command.

h.) Type a /T command (automatic test; refer to paragraph 4.1.11 for manual test) and the teletype starts to produce a tape. A tape will be produced which includes the information on the /U tape plus the information received during test one. The test one information will be printed out visually and as part of the tape at the same time. After the first part of the tape is produced (the /U equivalent), the teletype will print the column headings (S/P, I, C, D) for the measurements. When this is complete, the system will pause for the time allowed for soaking. Measurement data will then be printed out in visual and tape form (black, within tolerance; red, out of tolerance).

i.) When the test is complete, the teletype will wait for a new command. The command /O or /Q may be given at this point. A /O command will tell the computer to repeat the test just performed; a /Q will terminate test 1 and produce a form feed. When test 1 is complete, remove the tape just produced and mark it TEST 1.

4.1.6 Test 2.

To make a test 2 measurement, proceed as follows:

a.) Type a /R into the system (Figure 8).

b.) Load the TEST 1 tape into the reader and turn the reader on (RUN). Turn the reader off (STOP) after the part number information has started to print.

c.) If the operator is satisfied with the part number (indicating the correct tape), type a /S command and turn the tape reader on. The tape will run through the reader, print out the testing parameters in a semi-paragraph form and wait after TEST NO: 1 is printed. Turn the reader off.

d.) Type in the number 2 and depress the RETURN key. The teletype will print DATE: and the last date entered and wait.

e.) Type in the desired date for test 2 and depress the RETURN key. The teletype will type T & IR NO: and the last T and IR number and wait.

Figure 7. Test 1 data printout.

```
R

PART NUMBER:    TEST BOARD

S

C NOM (PF,NF,UF): 10NF   ↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF   LO LIM (%,PF,NF,UF):  150PF

DF LIM: 1.0   ↑DF LIM:  2%

BIAS TEST V:  1.5   FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA   ↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  25   SOAK TIME (MIN:SEC):  10

FIRST POS:  0   LAST POS: 6

STEPS:  1
```

Underlined information was typed upon request.

*Printed in red.

```
TEST NO:     1

DATE:    1/27/1970

T & IR NO:     1035 QZP23X

T




S/P          I          C          D

00        .03500    .00099*    .01230

01        .01800    .00966*    .00120

02        .03720    .09762    .00030

03        .01100    .96280    .02420

04        .11100    9.9540    .00320

05        1.3450*   104.98    .00530

06        3.3300*   1038.9*   .00180
```

Figure 3. Test 2 data printout.

```
R

PART NUMBER:    TEST BOARD

S

C NOM (PF,NF,UF): 10NF   ↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF   LO LIM (%,PF,NF,UF):  150PF

DF LIM: 1.0   ↑DF LIM:  2%

BIAS TEST V:  1.5   FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA   ↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  25   SOAK TIME (MIN:SEC):  10

FIRST POS:  0   LAST POS: 6

STEPS:  1
```

Underlined information was typed upon request.

*Printed in red.

```
TEST NO:  1  2

DATE: 1/27/1970   1/28/1970

T & IR NO:  1035 QZP28X   1430 QZP28X

T




S/P        ↑I         C        ↑C        ↑D

00       1.1710*  .00299*  1.0020   1.0000

01       .88800*  .00966*  1.0000   1.0000

02       .39100*  .09764   1.0000   1.0002

03       .00000*  .96280   1.0000   1.0000

04       1.1530*  9.9530   .99980   .94780*

05       1.6780*  165.03   1.0000   1.0000

06       1.3840*  1739.0*  1.0000   1.0000
```

f.) Type in the desired T and IR number for test 2 and depress the RETURN key. The teletype will wait for a new command.

g.) Type a /T command. The teletype will start to produce a new tape and then print S/P, ↑I, C, ↑C, ↑D headings and wait.

h.) Turn on the tape reader and the teletype will start printing the results of test 2 (black, within tolerance; red, out of tolerance) along with punching some more information on the tape started in step g. At the end of the test sequence, the teletype will wait for a new command. Turn the reader off. The command /O or /Q may be given at this point. A /O command will tell the computer to repeat the test just performed (Figure 9); a /Q will terminate test 2 and produce a form feed. If a /O command is used, turn the reader on and run it through the next set of data on the TEST 1 tape. Turn the reader off. Repeat for additional tests. When complete enter /Q.

i.) Remove the tape just punched and label it TEST 2.

4.1.7 Test Data Report.

To obtain a summary report of all the test data, proceed as follows:

a.) Load the /W overlay tape into the computer.

b.) Load the TEST 2 tape into the reader.

c.) Type a /R command (Figure 10). Turn the reader on, let the tape run through the part number data and turn the reader off.

d.) If the operator is satisfied with the part number (indicating the correct tape), type a /W command and turn the tape reader on. The teletype will automatically type the parameter data (Figure 10), the results of both tests one and two (black, within tolerance; red, out of tolerance), the signed difference between Test 1 and Test 2 measurements and wait for a new command (Figure 11). Turn the reader off. This output contains the data for a complete testing cycle.

If more than one test 1 and test 2 combination was made (/0 in paragraph 4.1.6h), a listing of this information may be desired. Depress the /0 button, turn the reader on and a summary will be printed of the second set of test information. This can be repeated for as many /0 commands as used in test 2 (Figures 12 and 13). Reload the /S overlay tape.

4.1.8 Test Abort.

If during the process of running an input tape it is desired to terminate the process, continue with the incorrect tape until the tape reaches a point where the system is waiting for a (/) command (the teletype is at the left-hand margin and waiting). Type a /Q command, the test will terminate and give a form feed. Remove the tape that was in the reader, install the correct tape and proceed with the proper test from the start. For example, if an incorrect T and IR NO. is entered (Figure 14), a /Q can be entered the next time the system is waiting at the left-hand margin of the printout for a command. The test will terminate and a form feed will result. After a /Q command has been given, return to the start of the desired test and proceed as usual.

```
00      1.0280  .00099* 1.0010  .87500*

01      1.0550* .00966* 1.0000  1.0000

02      .81000* .09764  1.0000  1.0000

03      2.1810* .96280  1.0000  1.0000

04      1.2700* 9.9540  1.0000  1.0000

05      1.1060* 105.00  1.0000  1.0000

06      1.3780* 1039.1* 1.0000  .88800*

O

00      1.1140* .00099* 1.0010  .87500*

01      .88800* .00966* 1.0000  1.0000

02      .81000* .09764  1.0000  1.0000

03      2.1810* .96280  1.0000  1.0000

04      1.1620* 9.9530  .99900  .94700*

05      1.0780* 105.00  1.0000  1.0000

06      1.3750* 1039.1* 1.0000  .88800*

Q
```

Figure 9. /O and /Q commands for test 1.

Underlined information was typed upon request.
*Printed in red.

```
R

PART NUMBER:    TEST BOARD

W

C NOM (PF,NF,UF): 10NF   ↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF   LO LIM (%,PF,NF,UF):  152PF

DF LIM: 1.0   ↑DF LIM:  2%

BIAS TEST V:  1.5   FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA   ↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  25   SOAK TIME (MIN:SEC): .10

FIRST POS:  0   LAST POS: 6

STEPS:  1   TEST NO:  2

DATE: 1/23/1970   T & IR NO:  1430 QZP2SX
```

Figure 10. Heading data for test data report.

Underlined information typed upon request.

Figure 11. Test data report for data set one.

```
S/P      I              C              D

00       0.035 NA       009.92 PF*     0.0128
         0.041 NA       009.94 PF*     0.0128
         0.006+NA*      000.02+PF      0.0000+
01       0.018 NA       096.67 PF*     0.0012
         0.016 NA       096.69 PF*     0.0012
         0.002-NA*      000.02+PF      0.0000+
02       0.037 NA       0976.2 PF      0.0063
         0.033 NA       0976.4 PF      0.0063
         0.004-NA*      0000.2+PF      0.0000+
03       0.011 NA       09.628 NF      0.0040
         0.000 NA       09.628 NF      0.0040
         0.011-NA*      00.000+NF      0.0000+
04       0.111 NA       099.54 NF      0.0038
         0.128 NA       099.53 NF      0.0036
         0.017+NA*      000.01-NF      0.0002-*
05       1.345 NA*      1049.8 NF      0.0053
         1.451 NA*      1050.0 NF      0.0053
         0.106+NA*      0000.2+NF      0.0000+
06       03.33 NA*      10.389 UF*     0.0018
         04.61 NA*      10.390 UF*     0.0018
         01.28+NA*      00.001+UF      0.0000+
```

Figure 12. Test data report for data set two.

```
0

00    0.035 NA     009.92 PF*    0.0128

      0.036 NA     009.93 PF*    0.0112

      0.001+NA     000.01+PF     0.0016-*

01    0.018 NA     096.67 PF*    0.0012

      0.019 NA     096.69 PF*    0.0012

      0.001+NA*    000.02+PF     0.0000+

02    0.037 NA     0976.2 PF     0.0003

      0.030 NA     0976.4 PF     0.0003

      0.007-NA*    0000.2+PF     0.0000+

03    0.011 NA     09.628 NF     0.0043

      0.024 NA     09.628 NF     0.0040

      0.013+NA*    00.000+NF     0.0003+

04    0.111 NA     099.54 NF     0.0038

      0.141 NA     099.54 NF     0.0038

      0.030+NA*    000.00+NF     0.0000+

05    1.345 NA*    1049.8 NF     0.0053

      1.488 NA*    1050.0 NF     0.0053

      0.143+NA*    0000.2+NF     0.0000+

06    03.33 NA*    10.389 UF*    0.0018

      04.59 NA*    10.391 UF*    0.0016

      01.26+NA*    00.002+UF     0.0002-*
```

Underlined information typed upon request.

*Printed in red.

Figure 13. Test data report for data set three.

```
0

00     0.035 NA        009.92 PF*     0.0128
       0.039 NA        009.93 PF*     0.0112
       0.004+NA*       000.01+PF      0.0016-*
01     0.018 NA        096.67 PF*     0.0012
       0.016 NA        096.67 PF*     0.0012
       0.002-NA*       000.00+PF      0.0000+
02     0.037 NA        0976.2 PF      0.0003
       0.030 NA        0976.4 PF      0.0003
       0.007-NA*       0000.2+PF      0.0000+
03     0.211 NA        09.628 NF      0.0040
       0.024 NA        09.628 NF      0.0040
       0.013+NA*       00.000+NF      0.0000+
04     0.111 NA        099.54 NF      0.0038
       0.129 NA        099.53 NF      0.0036
       0.018+NA*       000.01-NF      0.0002-*
05     1.345 NA*       1049.8 NF      0.0053
       1.450 NA*       1050.0 NF      0.0053
       0.105+NA*       0000.2+NF      0.0000+
06     03.33 NA*       10.389 UF*     0.0018
       04.58 NA*       10.391 UF*     0.0016
       01.25+NA*       00.002+UF      0.0002-*

1
```

Underlined information
typed upon request.
*Printed in red.

```
R

PART NUMBER:    TEST BOARD

S

C NOM (PF,NF,UF): 10NF   ↑C LIM (%,PF,NF,UF):  1%

UP LIM (%,PF,NF,UF):  5UF   LO LIM (%,PF,NF,UF):  150PF

DF LIM: 1.0   ↑DF LIM:  2%

BIAS TEST V:  1.5   FREQUENCY (KHZ,HZ): 1KHZ

IL LIM (NA,UA,MA):  1NA   ↑IL LIM (%,NA,UA,MA): 5%

LEAK TEST V:  25   SOAK TIME (MIN:SEC):  10

FIRST POS:  0   LAST POS: 6

STEPS:  1




TEST NO:      1

DATE:    1/27/1970

T & IR NO:      1025 ZQRT334   FIELD OVERFLOW

Q
```

Figure 14. Test abort.

Underlined information typed upon request.
*Printed in red.

4.1.9 Limit Specification.

4.1.9.1 General.

The limits typed in during paragraph 4.1.2 can be specified as percentage or by units (PF, NF, UF, NA, UA, MA) as explained in the following paragraphs.

4.1.9.2 ΔC LIM.

The capacitance deviation limit can be specified as a percentage, the allowable percent deviation between the capacitance of test two and the capacitance of test one ($\frac{\text{C TEST 2}}{\text{C TEST 1}}$ X 100) or as a number of units (PF, NP, UF), the allowable value that can separate the capacitance of test one and test two.

4.1.9.3 UP LIM.

The upper-limit capacitance value is the maximum value that the capacitance can vary in a positive direction from the nominal. If this limit is expressed as a percentage, the value typed should have a percent sign typed after the number (1%). This means that the capacitor can be up to 1% high in value and the results will be printed in black, indicating a value within the limit. This limit can also be specified as a unit value, say 41 PF. If 41 PF were typed into the system, it would mean that the capacitor under test can not exceed a value of 41 PF and be within the limit. A third way of expressing this limit is to type in +1 PF. This means that the upper limit is the nominal capacitance, 40 PF, plus 1 PF or 41 PF. Any of these limits can be used at any time. If it is desired to specify a limit as 1.0 PF, the nominal value of capacitance must also contain a decimal point, 40.0 PF.

4.1.9.4 LO LIM.

The lower-limit capacitance value is the minimum value that the capacitance can vary in a negative direction from the nominal. The limits for this entry can be expressed in three ways, the same as those in paragraph 4.1.9.3, except that a minus sign (-) should replace the plus sign (+) and all references are made to the lower limit.

4.1.9.5 DF LIM.

The dissipation-factor limit is a number equal to the maximum allowable dissipation factor for the test.

4.1.9.6 ΔDF LIM.

The dissipation-factor deviation limit is specified as a percentage. The value is the dissipation factor of test two divided by the dissipation factor of test one multiplied by one hundred, $\frac{\text{DF TEST 2}}{\text{DF TEST 1}}$ X 100 = %.

4.1.9.7 IL LIM.

The leakage-current limit is the maximum allowable value of leakage current for the test. The value must be expressed as a number of units (NA, UA, MA).

4.1.9.8 ΔIL LIM.

The leakage-current deviation limit can be expressed as a percentage, the allowable percentage deviation between the leakage current of test two and the leakage current of test one ($\frac{\text{IL TEST 2}}{\text{IL TEST 1}}$ X 100), or as a number of units (NA, UA, MA), the allowable value that can separate the leakage current of test one and test two.

4.1.10 Short-Lead Components.

When placing data into the system (paragraph 4.1.2), the determination of the STEP: entry may involve more than just typing a number. The test boards used in the Type 2995-9197 Test Fixture are designed to hold 100 components, but if the components to be tested have short leads some of the test locations cannot be used since the leads won't reach between terminals. Each socket position from 7 through 18 has a letter designator from A through L. The nineteenth component is the key. The system examines the position number while testing to determine what the next test position should be. If the STEPS: entry was 1, the system would go on to the number 20 position and continue; however, if components with short leads are mounted in positions 14 through 19, and 34 through 39, it is desirable to skip from position 19 to position 34. This is done by typing 1 H (one step at a time, skip to the 20 + 14 position or 34) in the STEPS: position. This entry, along with a FIRST POS: entry of 14 and a LAST POS: entry of 39, will tell the system to measure positions 14 through 19 in steps of 1, skip 20 through 33 and measure 34 through 39 in steps of one. The 20 n -1 positions, where n equals 1, 2, 3, or 4, are the key points. The system must go through these points (19, 39, 59, 79) in order to determine where to start testing the next group of twenty or less components, therefore, there must be a component in these positions if the position is included in the test. Table 3 lists the alpha-numeric relations and gives another example.

4.1.11 Manual Test.

A manual test can be made by typing a /M in step h of paragraph 4.1.5 or step g of paragraph 4.1.6. Manual testing means that the system will wait after each line of measurement data is printed out for a RETURN key command. When the RETURN key is depressed, the second line of data will be printed out and so forth until the test is complete.

TABLE 3

ALPHA-NUMERIC RELATIONS

Numeric Test Position	Alpha Value	Example
19	-	If components are mounted in every other position from 9 through 19, 29 through 39, 49 through 59, 69 through 79, and 89 through 99, the FIRST POS: entry should be 9, the LAST POS: entry should be 99, and the STEPS: entry should be 2D indicating every other step and skip to the 19 + D position (29).
18	L	
17	K	
16	J	
15	I	
14	H	
13	G	
12	F	
11	E	
10	D	
9	C	
8	B	
7	A	
6	-	
5	-	
4	-	
3	-	
2	-	
1	-	
0	-	

4.1.12 Data Interpretation.

The data printed out in test one is as follows (Figure 7):

S/P	I	C	D
Scanner Position	$\frac{\text{I TEST 1}}{\text{IL LIM}}$	$\frac{\text{C TEST 1}}{\text{C NOM}}$	$\frac{\text{DF TEST 1}}{\text{DF LIM}}$

The data printed out in test two is as follows (Figure 8):

S/P	I	C	C	D
Scanner Position	$\frac{\text{I TEST 2}}{\text{I TEST 1}}$	$\frac{\text{C TEST 2}}{\text{C NOM}}$	$\frac{\text{C TEST 2}}{\text{C TEST 1}}$	$\frac{\text{D TEST 2}}{\text{D TEST 1}}$

The data printed out in the test data report is as follows (Figure 11):

S/P	I	C	D
Scanner Position	I TEST 1 I TEST 2 ΔI (TEST 1-2)	C TEST 1 C TEST 2 ΔC (TEST 1-2)	D TEST 1 D TEST 2 ΔD (TEST 1-2)

4.1.13 Capacitance and Dissipation Testing Only.

To measure a group of components for capacitance and dissipation factor only (excluding leakage current), proceed as follows:

a.) Perform paragraph 4.1.1.

b.) Perform paragraph 4.1.2 through step j.

c.) At 4.1.2 k, do not enter a value for the leakage-current limit, just depress the RETURN key.

d.) At 4.1.2 l, do not enter a leakage-current deviation, just depress the RETURN key.

e.) At 4.1.2 m, do not enter a leakage test voltage, just depress the RETURN key.

f.) At 4.1.2 n, do not enter a soak time value, just depress the RETURN key.

g.) Proceed with step o and the remainder of the testing procedure as usual. The results when printed will show only capacitance and dissipation factor values, no leakage current values.

4.1.14 Leakage Current Testing Only.

To measure a group of components for leakage current only (excluding capacitance and dissipation factor), proceed as follows:

a.) Perform paragraph 4.1.1.

b.) Perform paragraph 4.1.2 through step c.

c.) At 4.1.2 d, do not enter a capacitance deviation value, just depress the RETURN key.

d.) At 4.1.2 e, do not enter an upper capacitance limit, just depress the RETURN key.

e.) At 4.1.2 f, do not enter a lower capacitance limit, just depress the RETURN key.

f.) At 4.1.2 g, do not enter a dissipation factor limit, just depress the RETURN key.

g.) At 4.1.2 h, do not enter a dissipation factor deviation, just depress the RETURN key.

h.) At 4.1.2 i, do not enter a bias voltage, just depress the RETURN key.

i.) At 4.1.2 j, do not enter a frequency value, just depress the RETURN key.

j.) Proceed with step k and the remainder of the testing procedure as usual. The results when printed will show only leakage current values, no capacitance and dissipation-factor values.

5.1 THEORY.

5.1.1 General.

The scanner in the Type 2990-9174 permits the automatic measurement of up to 100 components of series capacitance, dissipation factor and leakage current. In addition, the scanner provides electrification of the components under test from 10 s to 5 min. Figure 15 shows the connections

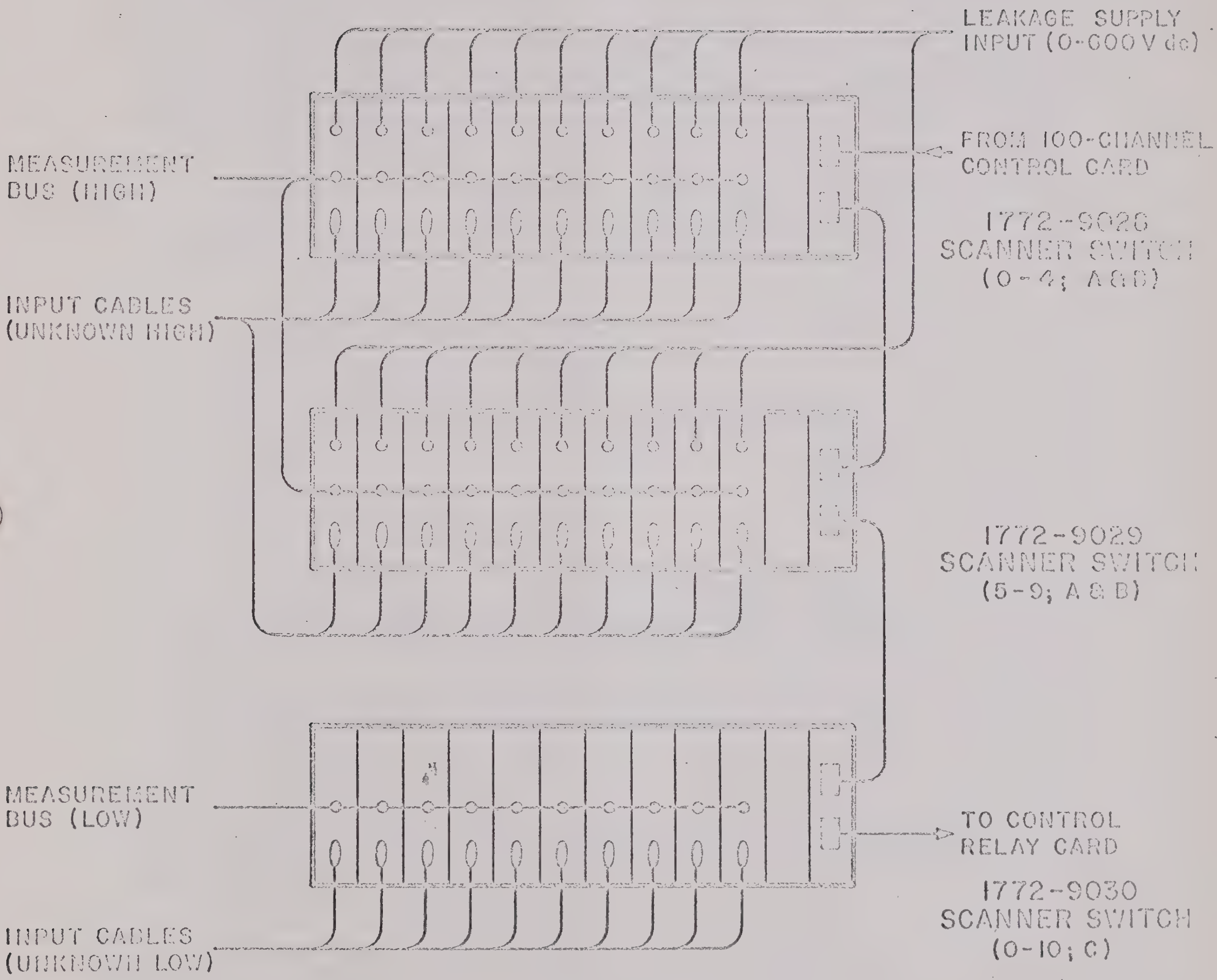

LEAKAGE SUPPLY INPUT (0-600 V dc)
FROM 100-CHANNEL CONTROL CARD
MEASUREMENT BUS (HIGH)
1772-9028 SCANNER SWITCH (0-4; A & B)
INPUT CABLES (UNKNOWN HIGH)
1772-9029 SCANNER SWITCH (5-9; A & B)
MEASUREMENT BUS (LOW)
TO CONTROL RELAY CARD
1772-9030 SCANNER SWITCH (0-10; C)
INPUT CABLES (UNKNOWN LOW)
2990-9174-7

Figure 15.

from the system to the scanner switches and Figure 16 indicates in a simplified form how the A, B and C relays are used to connect a test component. The test component is connected from the high measurement bus (A) to the low measurement bus (B) for a capacitance or dissipation factor measurement, and between the leakage supply input and the low measurement bus (B) for a leakage measurement.

The paragraphs that follow will detail the switching operation of the system according to Diagram 2990-9174-4D. This diagram is drawn with the C_{X0} component connected in a capacitance and dissipation-factor measurement configuration (paragraph 5.1.5).

5.1.2 Initial and Final Conditions.

The following are the relay positions at the start and finish of a measurement cycle:

Relay	Position
K00A, K01A, K02A, . . . K99A	a
K00B, K01B, K02B, . . . K99B	b
K00C, K01C, K02C, . . . K99C	a
K0D	b
K1D	b
K2D	b
K3D	b
K4D	a
K5D	b

Relays KX0A, KX0B, KX0C, K0D, and K5D as shown on Drawing 2990-9174-4D are not shown in the initial position since the drawing is in a capacitance and dissipation-factor measurement configuration.

Under the initial and final conditions, all the components under test are discharged and both terminals are grounded.

5.1.3 Test Component Electrification.

The test components in Drawing 2990-9174-4D are labelled CX0, CX1, CX2, etc. A typical test component, CiX, is electrified (charged) as follows:

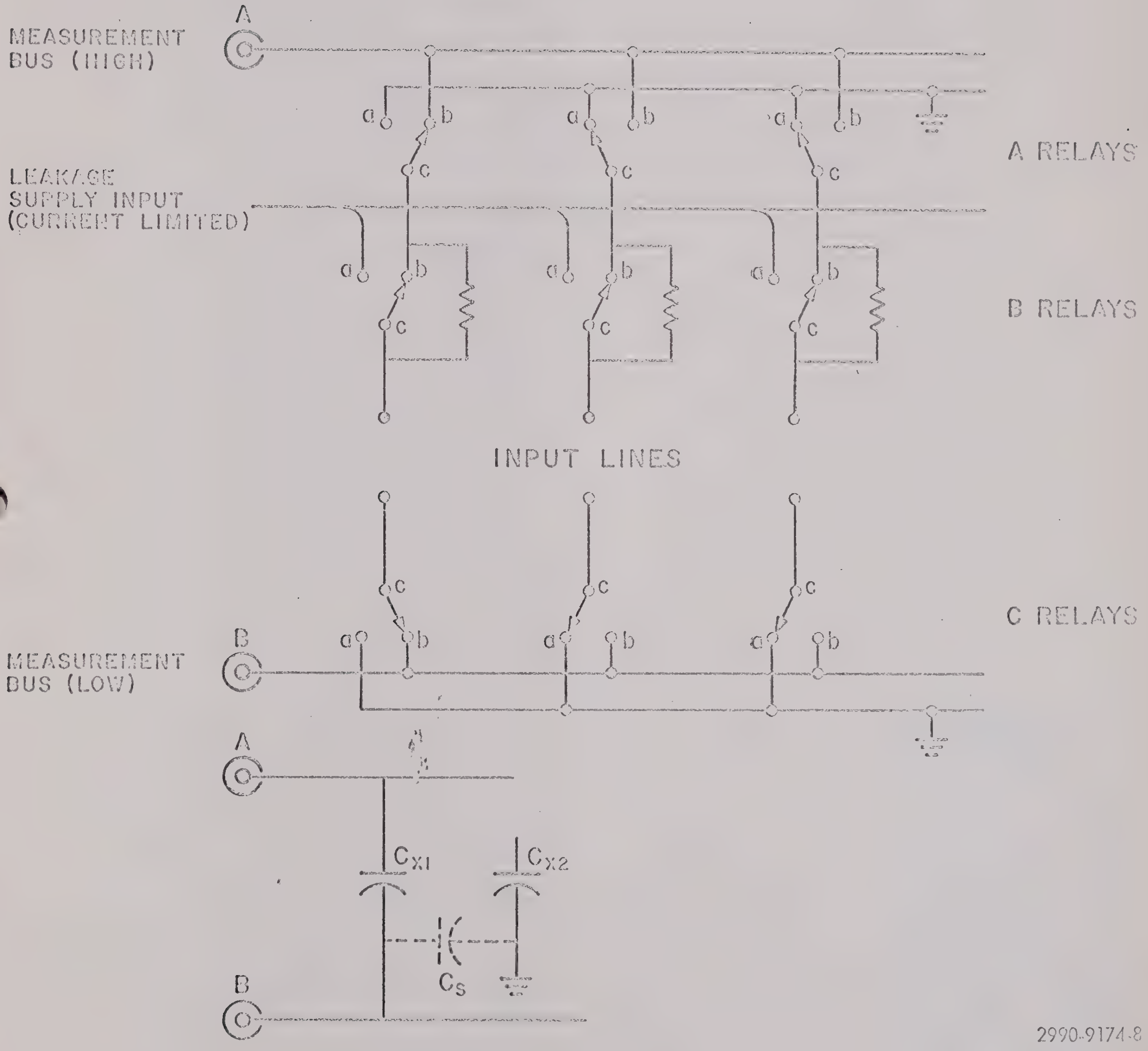
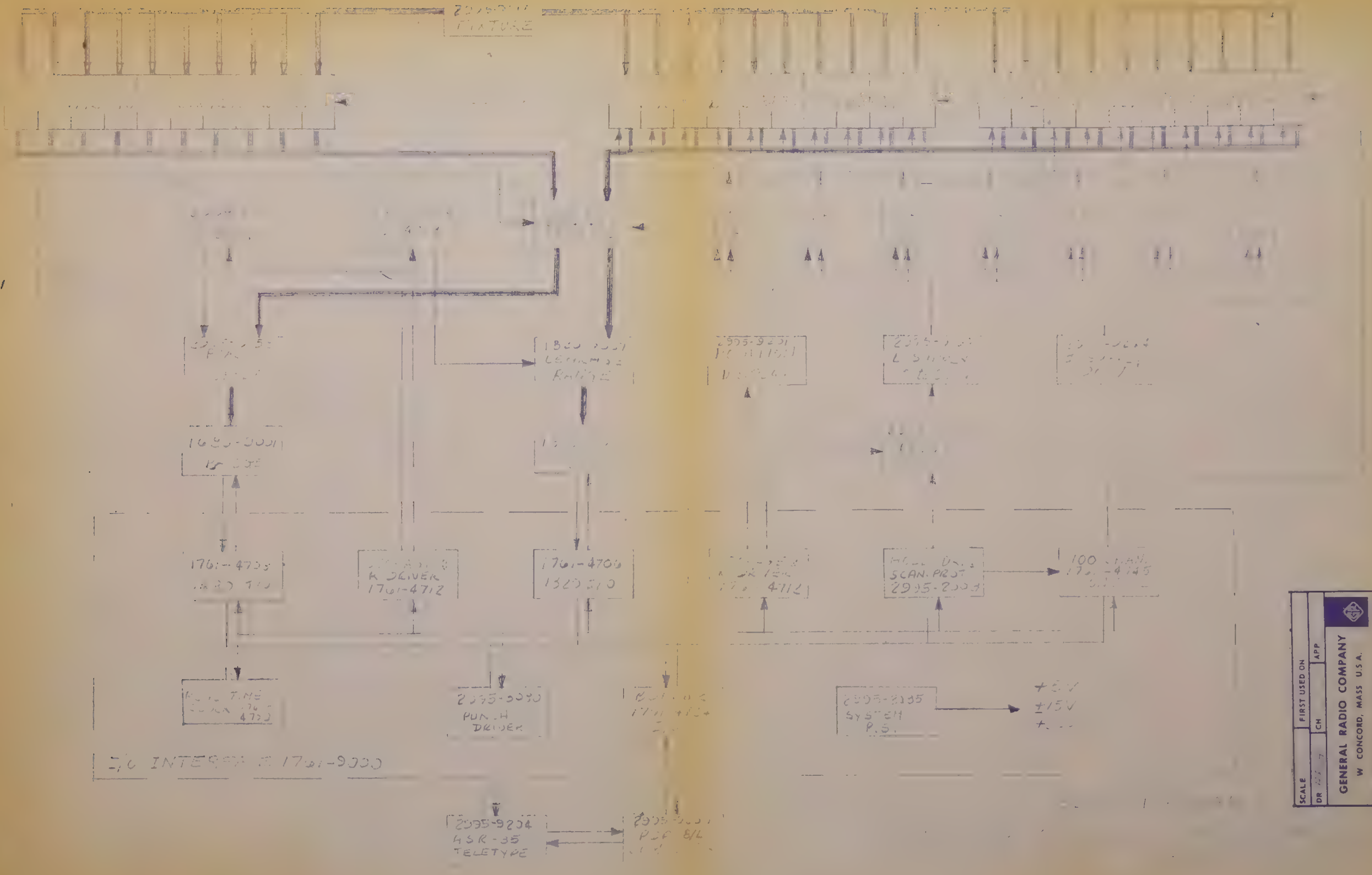
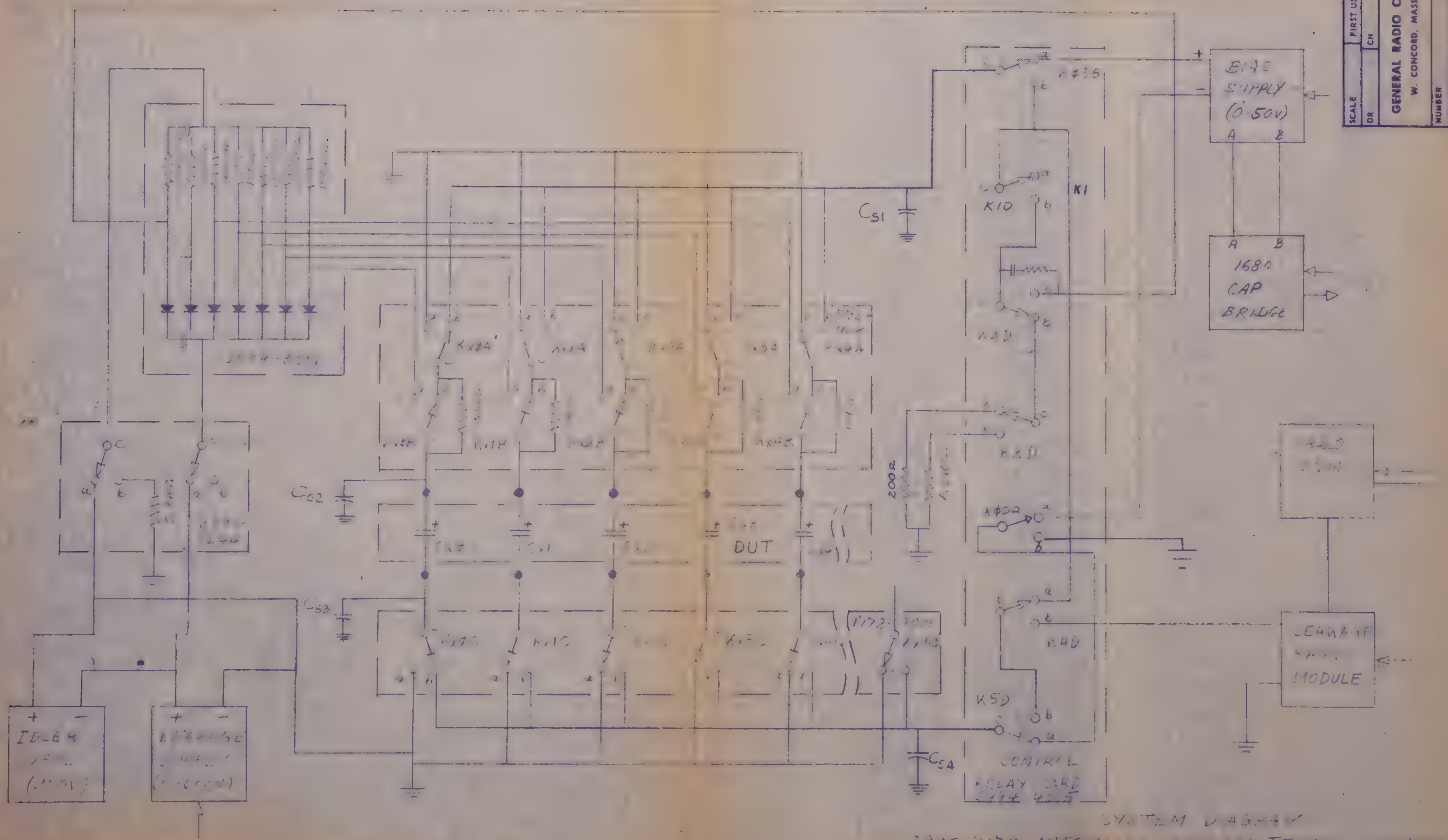

A
MEASUREMENT BUS (HIGH)
a
b
c
A RELAYS
LEAKAGE SUPPLY INPUT (CURRENT LIMITED)
B RELAYS
INPUT LINES
C RELAYS
B
MEASUREMENT BUS (LOW)
C_{X1}
C_{X2}
C_S
2990-9174-8

Figure 16.


2995-9?17
FIXTURE
1690-9001
1761-4709
R DRIVER
1761-4712
1761-4706
1520 S/0
4712
SCAN. PRST
2995-2003
100 SCAN.
4145
4709
2995-9090
PUNCH
DRIVER
I/O INTERFACE 1761-9090
2995-9204
ASR-35
TELETYPE
P&F B/L
2995-2155
SYSTEM
P.S.
+5V
±15V

SCALE
FIRST USED ON
DR
CH
APP
GENERAL RADIO COMPANY
W CONCORD, MASS U.S.A.
NUMBER
ISSUE


BIAS SUPPLY (0-50V)
+
−
A
B
1680 CAP BRIDGE
K1
K10
a
b
C_{S1}
C_{S2}
C_{S3}
C_{S4}
200Ω
DUT
K5D
K4D
K3D
CONTROL RELAY CARD
LEAKAGE PAR MODULE
IDLER
+
−

SYSTEM DIAGRAM

2990-9174 AUTO[illegible] [illegible] TESTING SYSTEM

SCALE
FIRST USED ON
DR
CH
APP
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.
NUMBER 2990-9174-4D
ISSUE

	Sequence									
Step	Relay	Position Set to	Voltage Switched (V)	Current Switched (mA)	CiX (V)	CS1 (V)	CS2 (V)	CS3 (V)	CS4 (V)
1	Relays in initial conditions.		0	0	0	0	0	0	0
2	KiA	b	0	0	0	0	0	0	0
3	KiC	b	0	0	0	0	0	0	0
4	K2D	a	600	8	0	↗600	↗600	↗600	↗600
5	KiB	a	0	0	0	600	600	600	600
6	K2D	b	600	500	↗600	↘0	=CiX	↘0	↘0
7	K3D	a	0	0	↗600	0	=CiX	0	0
8	KiA	a	0	0	↗600	0	=CiX	0	0
9	KiC	a	0	0	↗600	0	=CiX	0	0
10	K3D	b	0	0	600	0	=CiX	0	0

The sequence begins with all the relays set in the initial condition as shown in paragraph 5.1.2. Then, relay KiA, located on the 1772-9018 SPDT Switch Module, and KiC, located on the 1772-9019 SPDT Switch Module, are set to their b positions as preconditions to the charging of CiX. Relay K2D is set to the a position, causing the stray bus-wire capacitances (CS1, CS2, CS3, CS4) to begin to charge to the voltage set at the leakage supply. For the general case a 600-V setting is used since this is the maximum value that the circuit will see. CiX doesn't start to charge at this point because both sides of the capacitor are connected to the 600-V supply.

Step five is the setting of KiB to the a position. By this time the stray capacitances have reached the steady-state value of 600 V and CiX remains at 0 because when KiB is set to a, CiX still has 600 V applied to each side. K2D is now switched to the b position, removing the 600-V potential from the low side of the test component, CiX, and connecting this side of CiX to ground through a 1.2-kΩ resistor. Since one side of CiX is connected to the 600-V supply and the other side is connected to ground through a 1.2-kΩ resistor, CiX will begin to charge towards 600 V. At the same time, three of the strays (CS1, CS3, CS4) will discharge since their high side has a path to ground through the 1.2-kΩ resistor. The voltage across CS2 will be the same as that at CiX since they are effectively in parallel.

To accelerate the discharge of CS1, CS2 and CS4, the 1.2 kΩ resistor is replaced by a 200-Ω resistor. Step eight is the setting of KiA to the a position. This doesn't affect the circuit at this point because all terminals of relay KiA are at ground potential. KiC is then set to the a position (ground), which doesn't affect the circuit because the low side of

CiX is already at approximately ground potential. K3D is now switched back to the b position, leaving CiX in a charging condition and all strays except CS2 in a discharged condition.

5.1.4 Leakage Test.

The switching sequence of the system to allow a leakage test starts with the electrification sequence given in paragraph 5.1.3 and continues as follows:

Sequence									
Step	Relay	Position Set to	Voltage Switched (V)	Current Switched (V)	CiX (V)	CS1 (V)	CS2 (V)	CS3 (V)	CS4 (V)
1	KiC	b	≈0	<8	600	0	600	≈0	≈0
2	K4D	b	≈0	<8	600	0	600	0	0
Measure IL		-	-	-	-	-	-	-	-
3	K4D	a	≈0	<8	600	0	600	0	0
4	KiC	a	≈0	<8	600	0	600	0	0
5	KiA	b	0	0	600	0	600	0	0
6	K2D	a	600	<8	600	↗600	600	0	0
7	K1D	a	0	0	600	=CiX	=CiX	0	=CiX
8	KiB	b	≈0	≈0	600	=CiX	=CiX	0	=CiX
9	K1D	b	≈0	≈0	↗600	↗600	↗600	0	↗600
10	K2D	b	600	500	↘0	↘0	↘0	0	↘0
11	K3D	a	<100	500	↘0	↘0	↘0	0	↘0
12	KiA	a	0	0	0	0	0	0	0
13	K3D	b	0	0	0	0	0	0	0

The sequence begins with the test component charged and the relays set as established at the completion of paragraph 5.1.3.

The first two steps of this procedure (KiC to b and K4D to b) connect the test component to the Leakage Range Module for measurement of the leakage current. After the measurement is complete, K4D is reset to its a position, KiC to its a position, and KiA to its b position. The switching of these relays doesn't affect the circuit, i.e., CiX and CS2 are still at 600 V.

Step 6 calls for K2D to go to its a position. This connects the leakage supply across CS1, charging it to 600 V. K1D is then set to its a position, KiB to its b position and K1D back to its b position. This procedure causes the voltages in CS1 and CS2 to equalize through the 10 MΩ resistor to protect KiB even under short-circuit conditions.

In step 10, K2D is set to its b position causing CiX, CS1 and CS2 to discharge towards zero through a 1.2-kΩ resistor. Since this discharge curve is of an exponential form, K3D is set to its a position when the discharge curve begins to flatten out. With K3D in the a position, the discharge speed is increased because a 0.2-KΩ resistor replaces the 1.2-kΩ resistor. KiA is then set to its a position to ground the high side of the capacitor and K3D is returned to its b position for the start of the next measurement cycle.

5.1.5 Capacitance and Dissipation Factor Test.

The switched sequence for a capacitance and dissipation factor test starts from the initial conditions (paragraph 5.1.2) and continues as follows:

Sequence									
Step	Relay	Position Set to	Voltage Switched (V)	Current Switched (V)	CiX (V)	CS1 (V)	CS2 (V)	CS3 (V)	CS4 (V)
1	KiC	b	0	0	0	0	0	0	0
2	K0D	a	0	0	0	0	0	0	0
3	K5D	a	50	40	↗50	0	0	↗50	↗50
4	KiA	b	0	40	↗50	0	0	↗50	↗50
Measure C&DF –			–	–	–	–	–	–	–
5	KiA	a	0	40	50	0	0	50	50
6	K5D	b	50	42	↘0	0	0	↘0	↘0
7	K0D	b	0	0	0	0	0	0	0
8	KiC	a	0	0	0	0	0	0	0

The sequence begins with the test component discharged and both ends connected to ground. Relay KiC is set to its b position and K0D to its a position to establish almost a complete circuit from the bias supply + terminal to the terminal through the test component CiX. The only break in the connection is at relay K5D. The next step is to set K5D to its a position and charge CiX to 50 V or the bias supply voltage (50 V is maximum). CS3 and CS4 also get charged to the 50-V level at the same time.

NOTE

> The bias supply is charging the test component with a negative potential, i.e., the -side of the supply is applied to the -side of the test component while the +side of the test component and the bias supply are connected to ground.

KiA is then switched to its b position and a system measurement is conducted. At the completion of the measurement, KiA is switched back to its a position (ground) and K5D is set to its b position causing the test component (CiX), CS3 and CS4 to discharge through the 1.2 kΩ resistor.

K0D is then switched to its b position and KiC to its a position. This completes the measurement and the system is set to its initial and final conditions.

6.1 SERVICE AND MAINTENANCE.

6.1.1 General.

The system service and maintenance can be divided into two sections; calibration and maintenance of the system.

6.1.2 Calibration.

6.1.2.1 Subsystem Calibration.

There are five instruments in the testing system that may need periodic calibration. These instruments are as follows:

1.) Type 1680 Automatic Capacitance Bridge
2.) Type 1820 Digital Voltmeter
3.) Type 2995-9282 Bias Supply
4.) Type 2995-9264 Power Supply
5.) Type 2995-9199 Power Supply

The 1680 can be calibrated according to the instructions given in the Type 1680 Instruction Manual after the following two steps have been performed:

a.) Set the MEASUREMENT RATE switch to a position other than MANUAL.

b.) Disconnect input cables to the front-panel A and B connectors. This allows external standards to be connected for calibration.

The 1820 can be calibrated according to the instructions given in the Type 1820 Instruction Manual after the following:

a.) Unlock the Leakage Range Module from the front of the 1820 by turning the LOCK control counterclockwise and disconnecting the external plugs.

b.) Initialize the system so that the 1820 will be free running (see system listing).

c.) Calibrate the 1820 with a digital voltmeter calibrator such as the GR 1822 Digital Voltmeter Calibrator.

The 2995-9282 Bias Supply must be checked by using the computer to control its voltage value. The bias supply should be checked as follows:

a.) Disconnect the front-panel B output and the rear-panel (-) connection (BNC).

b.) Connect a voltmeter between these two test points, (+) to the B output, (-) to the (-) output.

c.) Enter the desired voltage using the short test program supplied and the computer SWITCH REGISTER.

d.) Check the voltages from 0 to 50 with the voltmeter. The 2995-9158 Bias Supply Instruction Manual gives typical voltage accuracies and adjustment procedures.

The 2995-9264 Power Supply is the manually operated idler supply. Checks on its output can be made according to the information given in the Kepco Model BHK 500-0.4 (M) Instruction Manual. The output voltage (200 V) can be set directly by the front panel.

The 2995-9199 Power Supply is the programmable supply and can be checked by setting voltage levels through the use of the test program supplied and the computers SWITCH REGISTER. Proceed as follows:

a.) Refer to the supplied listing with the 2995-9199 Supply testing tape.

b.) Disconnect P69 at J1 on the 2995-9244 High-Voltage Protection Unit.

c.) Line-load checks can be performed with the information supplied on the Kepco Model BHK 1000-0.2 (M) Instruction Manual.

6.1.2.2 System Calibration.

The leakage current measurement part of the system does not require any calibration and should only be checked for accuracy.

The C and DF measurement part of the system uses software correction factors which have to be determined. These constants are:

1.)	1 kHz	Series inductive reactance (X2C)
		Series resistance (R2C)
		Stray capacitance (CSC, CSC2)
		Conductance correction factor (GCC)
2.)	400 Hz	Series inductive reactance (X2B)
		Series resistance (R2B)
		Stray capacitances (CSB, CSB2)
		Conductance correction factor (GCB)
3.)	120 Hz	Series inductive reactance (X2A)

To determine the correction factors, refer to Table 6-1 and proceed as follows:

a.) Connect the short circuit test board. Record the (-C) and G readings of the 1680 bridge for each scanner position at 1 kHz, 400 Hz and 120 Hz (see sample Short Circuit Measurement Chart). Find the two positions with the highest and lowest C and G readings at each test frequency. Calculate X2 high, X2 low, R2 high and R2 low for each test frequency. Calculate X2 mean and R2 mean.

$$\text{X2 mean} = \frac{\text{X2 low} + \text{X2 high}}{2}$$

$$\text{R2 mean} = \frac{\text{R2 low} + \text{R2 high}}{2}$$

The correction factors are:

X2C = X2 mean (@ 1 kHz)
X2B = X2 mean (@ 400 Hz)
X2A = X2 mean (@ 120 Hz)
R2C = -R2 mean (@ 1 kHz)
R2B = -R2 mean (@ 400 Hz and 120 Hz)

b.) Connect the open circuit test board. Record the C and (-G) readings of the 1680 bridge for each scanner position at 1 kHz and 400 Hz only. Find the highest and lowest value of stray capacitance for each test frequency for all scanner positions except positions 18, 19, 38, 39, 58, 59, 78, 79, 98, 99. Calculate the mean stray capacitances

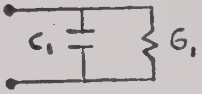
CSC = -(mean stray capacitance @ 1 kHz)
CSB = -(mean stray capacitance @ 400 Hz)

TABLE 6-1

CORRECTING PARALLEL MEASUREMENTS FOR UNWANTED SERIES PARAMETERS

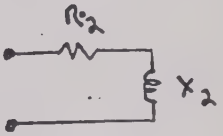
A. Determining Correction Terms

1) Short Circuit Component. Measure $-C_1$, G_1



2) Calculate Correction Terms:

$$D_1 = \frac{G_1}{\omega C_1},\ D_1^{2},\ 1 + D_1^{2}$$

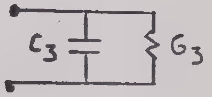


$$X_2 = \frac{1}{\omega C_1} \frac{1}{1 + D_1^2} \text{ (inductive)}$$

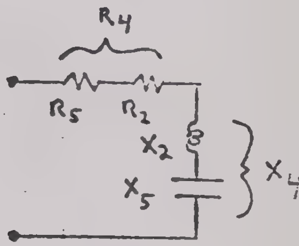
$$R_2 = \frac{1}{G_1} \frac{D_1^2}{1 + D_1^2}$$

B. Making Corrections

3) Measure Component. C_3, G_3



4) Subtract stray capacitance: $C'_3 = C_3 - C_{stray}$



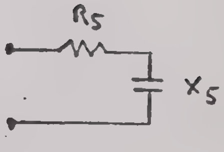
5) Calculate Series Terms:

$$D_3 = \frac{G_3}{\omega C'_3},\ D_3^{2},\ 1 + D_3^{2}$$

$$X_4 = \frac{1}{\omega C'_3} \frac{1}{1 + D_3^2}$$

$$R_4 = X_4 D_3$$

6) Subtract Correction Terms:



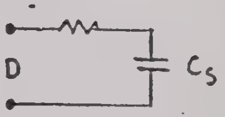
$$X_5 = X_4 + X_2 \text{ (inductive)}$$

$$R_5 = R_4 - R_2$$

7) Calculate Desired Parameters:

$$\text{Dissipation factor} = \frac{R_5}{X_5}$$

$$\text{Series C} = C_s = \frac{1}{\omega X_5}$$



Determine the mean stray capacitance of the ten high positions listed above for each frequency. The correction factors are:

CSC2 = -(high mean stray capacitance @ 1 kHz)
CSB2 = -(high mean stray capacitance @ 400 Hz)

c.) The next step is to translate all correction factors into a three word floating point format. Proceed as follows:

1. Set the DC POWER switches of the Kepco Power Supplies, Models BHK 500 and BHK 1000 to OFF.
2. Load DEC tapes ODT (LOW) (DEC-08-COC1-PB) and FLOATING POINT PACKAGE 1 (DEC-08-YQ1A-PB) into the computer.
3. Load GR tape DECIMAL TO FLOATING POINT into the computer.
4. Set the switch register to 200, depress LOAD ADD and START. The teletypewriter will print "FLTG:".
5. Type the decimal number to be converted into a three (3) word floating-point format and depress the RETURN key. The teletypewriter will print the three (3) word conversion, then "FLTG:" and wait for a new decimal number.

Example:
```
FLTG: - .22E-12
7726
4102
3250

FLTG:
```

6. Repeat step 5 for each decimal number to be converted. When all the constants have been converted, depress the STOP key on the computer.
7. Complete the form for system constants, Table 6-2. A sample conversion printout and a system-constant form are shown in Tables 6-3 and 6-4, respectively.
8. Set switch register to 1000, depress LOAD ADDR and START. Use ODT to type all system constants into the computer at the specified locations (MEM PROT switch down). Use ODT and the instructions supplied in the DEC software package to punch an overlay tape for the new system constants. Punch the following blocks:

571-576
3771-3776
4773-4775
5575-5577
5744-5751
7672-7703

After reloading the main system tape, load the tape obtained above.

6.1.3 Maintenance.

One master maintenance tape is supplied with the title Leakage, C and DF System Test tape. Also supplied is a listing of the information on this tape, a listing of eight (8) diagnostic messages, and listings for various trouble analysis and calibration tapes. The general maintenance procedure is as follows:

a.) Load the master maintenance tape.

b.) Run through the testing sequences on the master tape until a fault is located. If the fault point is associated with one of the eight diagnostic messages, the proper message will be printed on the teletype.

Follow the directive of this message or if a message doesn't print out, find the location of the fault on the program listing and determine what instrument, interface card or relay the problem might be associated with.

c.) Use the proper test program for that component and run the test.

d.) If the test in step c locates the fault, reconnect the entire system and resume test measurements. If the test in step c doesn't show a trouble in the component picked for analysis, select another test program and continue until the fault is located. The listing for each test program is self explanatory.

TABLE 6-2

GR2990-9174 SYSTEM CONSTANTS

X2A	7672/ 7673/ 7674/	FLTG +	
X2B	7675/ 7676/ 7677/	FLTG +	
R2B	5575/ 5576/ 5577/	FLTG -	
CSB	0571/ 0572/ 0573/	FLTG - .	E-12
CSB2	3771/ 3772/ 3773/	FLTG - .	E-12
GCB	5744/ 5745/ 5746/	FLTG +	E-10
X2C	7700/ 7701/ 7702/	FLTG +	
R2C	4773/ 4774/ 4775/	FLTG -	
CSC	0574/ 0575/ 0576/	FLTG - .	E-12
CSC2	3774/ 3775/ 3776/	FLTG - .	E-12
GCC	5747/ 5750/ 5751/	FLTG +	E-9

TABLE 6-3

```
                                DATE: 3/12/1970

          GR 2990-9174 SYSTEM CONSTANTS
          -----------------------------


FLTG :.021

7773
2540
2031

FLTG :.0993

7775
3132
7346

FLTG :-1.21

0001
5450
7534

FLTG :-.22E-12

7726
4102
3250

FLTG :-.41E-12

7727
4311
4143

FLTG :6E-10

7742
2447
3240

FLTG :.246

7776
3737
1667

FLTG :-1.24

0001
5412
1727

FLTG :-.32E-12

7727
5136
6622
```

```
FLTG :-.49E-12

7730
5660
4745

FLTG :4E-9

7745
2113
4060
```

TABLE 6-4

GR2990-9174 SYSTEM CONSTANTS

X2A	7672/7773 7673/2540 7674/2031	FLTG + .021
X2B	7675/7775 7676/3132 7677/7346	FLTG + .0993
R2B	5575/0001 5576/5450 5577/7534	FLTG - 1.21
CSB	0571/7726 0572/4102 0573/3250	FLTG - .22 E-12
CSB2	3771/7727 3772/4311 3773/4143	FLTG - .41 E-12
GCB	5744/7742 5745/2447 5746/3240	FLTG + 6 E-10
X2C	7700/7776 7701/3737 7702/1667	FLTG + .246
R2C	4773/0001 4774/5412 4775/1727	FLTG - 1.24
CSC	0574/7727 0575/5136 0576/6622	FLTG - .32 E-12
CSC2	3774/7730 3775/5660 3776/4745	FLTG - .49 E-12
GCC	5747/7745 5750/2113 5751/4060	FLTG + 4 E-9

GENERAL RADIO COMPANY
WEST CONCORD • MASSACHUSETTS, 01781

TEL. 617 369-4400 (Concord)
617 646-7400 (Boston)
TWX 710 347-1051

SYSTEM WARRANTY

We warrant that this system is free from defects in material and workmanship and when properly used, it will perform in accordance with applicable specifications for a period of ninety days after original shipment. Any system that is found within the ninety-day period not to meet these standards, after examination by our factory, district office, or authorized repair personnel, will be repaired, or at our option, replaced without charge.

The several instruments in this system have individual warranties. Those manufactured by General Radio Company are warranted for a period of two years after original shipment. Those not manufactured by General Radio Company have the warranty provided by the manufacturer.

OUR LIABILITY IS LIMITED TO THE ABOVE WARRANTY OF REPAIR OR REPLACEMENT OF THE SYSTEM AND SPECIFICALLY EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL DAMAGES ARISING OUT OF FAILURE OF THE SYSTEM.

SERVICE

The warranty attests to the quality of materials and workmanship in our products. When difficulties occur which cannot be corrected using the service instructions, write or telephone the nearest General Radio service department giving full information concerning the difficulty.

Upon evaluation of this information, our Service personnel will recommend field servicing or the return of the equipment to General Radio Company for repair.

If the equipment must be returned, the Service Department will issue a Return Material Tag to insure proper handling and identification. If the warranty has expired, a purchase order should be forwarded to avoid unnecessary delay.

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FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00192	Jones Mfg. Co, Chicago, Illinois
00194	Walsco Electronics Corp, L.A., Calif.
00434	Schweber Electronics, Westburg, L.I., N.Y.
00656	Aerovox Corp, New Bedford, Mass.
01009	Alden Products Co, Brockton, Mass.
01121	Allen-Bradley, Co, Milwaukee, Wisc.
01295	Texas Instruments, Inc, Dallas, Texas
02114	Ferroxcube Corp, Saugerties, N.Y. 12477
02606	Fenwal Lab Inc, Morton Grove, Ill.
02660	Amphenol Electron Corp, Broadview, Ill.
02768	Fastex, Des Plaines, Ill. 60016
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03636	Grayburne, Yonkers, N.Y. 10701
03888	Pyrofilm Resistor Co, Cedar Knolls, N.J.
03911	Clairex Corp, New York, N.Y. 10001
04009	Arrow-Hart & Hegeman, Hartford, Conn. 06106
04713	Motorola, Phoenix, Ariz. 85008
05170	Engr'd Electronics, Santa Ana, Calif. 92702
05624	Barber-Colman Co, Rockford, Ill. 61101
05820	Wakefield Eng, Inc, Wakefield, Mass. 01880
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co), Baraboo, Wisc.
07261	Avnet Corp, Culver City, Calif. 90230
07263	Fairchild Camera, Mountain View, Calif.
07387	Birtcher Corp, No. Los Angeles, Calif.
07595	Amer Semicond, Arlington Hts, Ill. 60004
07828	Bodine Corp, Bridgeport, Conn. 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07983	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc. 53115
08730	Vemaline Prod Co, Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass. 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn.
12498	Crystalonics, Cambridge, Mass. 02140
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg Co, Inc, Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semicondictors, W.Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co, Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15238	ITT, Semiconductor Div, Lawrence, Mass.
15605	Cutlet-Hammer Inc, Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
17771	Singer Co, Diehl Div, Somerville, N.J.
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zettlet Inc, Costa Mesa, Calif.
28520	Hayman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif.
30874	I.B.M, Armonk, New York
32001	Jensen Mfg. Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
38443	Marlin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn. 55408
42190	Muter Co, Chicago, Ill. 60638
42498	National Co, Inc, Melrose, Mass. 02176
43991	Norma-Hoffman, Stanford, Conn. 06904
49671	RCA, New York, N.Y. 10020
49956	Raytheon Mfg Co, Waltham, Mass. 02154
53021	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston, Ill.
56289	Sprague Electric Co, N. Adams, Mass.
59730	Thomas and Betts Co, Elizabeth, N.J. 07207
59875	TRW Inc, (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg Co, Torrington, Conn.
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass.
63060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-India Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill. 60644
71126	Bronson, Homer D, Co, Beacon Falls, Conn.
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71468	ITT Cannon Elec, L.A., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc, 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif. 90241
72136	Electro Motive Mfg Co, Wilmington, Conn.
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif. 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W.Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73899	JFD Electronics Corp, Brooklyn, N.Y.
74193	Heinemann Electric Co, Trenton, N.J.
74861	Industrial Condenser Corp, Chicago, Ill.
74970	E.F. Johnson Co, Waseca, Minn. 56093
75042	IRC Inc, Philadelphia, Penn. 19108
75382	Kulka Electric Corp, Mt. Vernon, N.Y.
75491	Lafayette Industrial Electronics, Jamica, N.Y.
75608	Linden and Co, Providence, R.I.
75915	Littelfuse, Inc, Des Plaines, Ill. 60016
76005	Lord Mfg Co, Erie, Penn. 16512
76149	Mallory Electric Corp, Detroit, Mich. 48204
76487	James Millen Mfg Co, Malden, Mass. 02148
76545	Mueller Electric Co, Cleveland, Ohio 44114
76684	National Tube Co, Pittsburg, Penn.
76854	Oak Mfg Co, Crystal Lake, Ill.
77147	Patton MacGuyer Co, Providence, R.I.
77166	Pass-Seymour, Syracuse, N.Y.
77263	Pierce Roberts Rubber Co, Trenton, N.J.
77339	Positive Lockwasher Co, Newark, N.J.
77542	Ray-O-Vac Co, Madison, Wisc.
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Ill. Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S.Braintree, Mass.
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79725	Wiremold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80030	Prestole Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assoc, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass.
80211	Motorola Inc, Franklin Park, Ill. 60131
80258	Standard Oil Co, Lafeyette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80431	Air Filter Corp, Milwaukee, Wisc. 53218
80583	Hammarlund Co, Inc, New York, N.Y.
80740	Beckman Instruments, Inc, Fullerton, Calif.
81030	International Insturment, Orange, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81143	Isolantite Mfg Corp, Stirling, N.J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Ledex Inc, Dayton, Ohio 45402
81860	Barry-Wright Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82273	Indiana Pattern & Model Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
82807	Milwaukee Resistor Co, Milwaukee, Wisc.
83033	Meissner Mfg, (Maguire Ind) Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass.
83186	Victory Engineering, Springfield, N.J. 07081
83361	Bearing Specialty Co, San Francisco, Calif.
83587	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84835	Lehigh Metal Prods, Cambridge, Mass. 02140
84971	TA Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA (Elect. Comp & Dev), Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell-Dubilier, Fuquay-Varina, N.C.
88627	K & G Mfg Co, New York, N.Y.
89482	Holtzer-Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93916	Cramer Products Co, New York, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung Sol Electric Inc, Newark, N.J.
95076	Garde Mfg Co, Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
95354	Methode Mfg Co, Chicago, Ill.
95412	General Electric Co, Schenectady, N.Y.
95794	Anaconda Amer Brass Co, Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp, Orlean, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thordarson-Meissner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Jonesville, Wisc, 53545
96906	Military Standards
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Compar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99180	Transitron Electronics Corp, Melrose, Mass.
99313	Varian, Palo Alto, Calif. 94303
99378	Atlee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

SCANNER CONTROL BOX

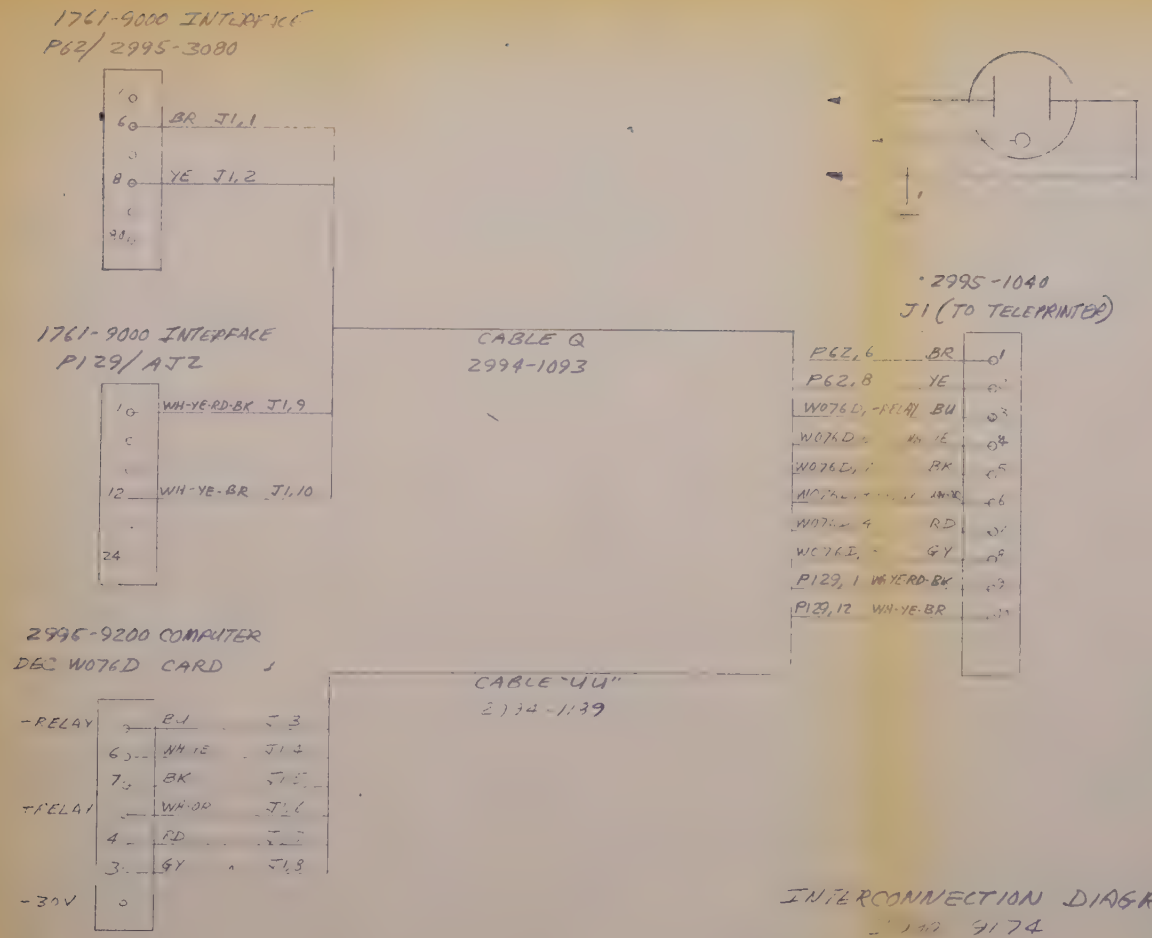
TO

SCANNER SWITCH

INTERCONNECTIONS

From 2995-9202, AJ3	To 1772-9028 Scanner Switch	Color
P42, 1	P47, C12	
2	A12	
3	B2	
7	B9	
9	D9	
11	C8	
12	E7	
13	F7	
14	D7	
15	E8	
17	F7	

Wire: ESMW 5-2-24


1761-9000 INTERFACE
P62/ 2995-3080
1
6
8
BR J1,1
YE J1,2
1761-9000 INTERFACE
P129/AJ2
1
12
24
WH-YE-RD-BK J1,9
WH-YE-BR J1,10
2995-9200 COMPUTER
DEC W076D CARD
-RELAY
6
7
+RELAY
4
3
-30V
BU J1,3
WH-YE J1,4
BK J1,5
WH-OR J1,6
RD J1,7
GY J1,8
CABLE Q
2994-1093
CABLE "UU"
2994-1139
2995-1040
J1 (TO TELEPRINTER)
P62,6 BR 1
P62,8 YE 2
W076D, -RELAY BU 3
W076D WH-YE 4
W076D BK 5
W076D WH-OR 6
W076D 4 RD 7
W076D GY 8
P129,1 WH-YE-RD-BK 9
P129,12 WH-YE-BR 10

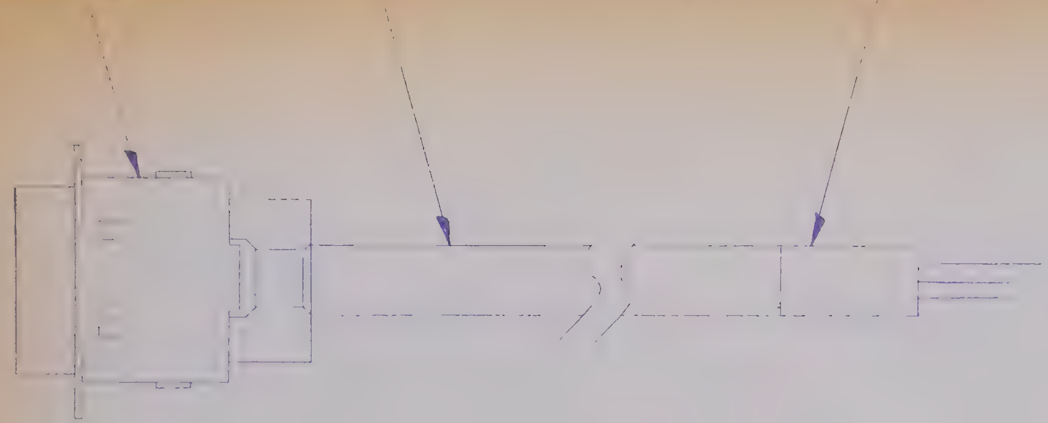
INTERCONNECTION DIAGRAM

9174

SCALE
FIRST USED ON
DR AEK
CH
APP

GENERAL RADIO COMPANY
W CONCORD, MASS U.S.A.

NUMBER 9174
ISSUE 1



RVICE LEADS .250 THIS END

SERVICE LEADS THIS END
AS NEEDED IN ASM.

TT EXTENSION CABLE ASM.
2994-1094

4220-5310 CONNECTOR PIN	COLOR	ESMW-	LENGTH
1	BR	5-2L-20	13'
2	YE	5-2L-20	13'
9	WH-YE-RD-BK	5-2L-24	19'
10	WH-YE-BR	5-2L-24	19'

3	-RELAY
4	6
5	7
6	+RELAY
7	4
8	3

* SEE ASR35 TELEPRINTER MANUAL

* STANDARD CABLE FROM ASR35 TELEPRINTER

DATE: 15 Mar. 67 | ISSUE 1

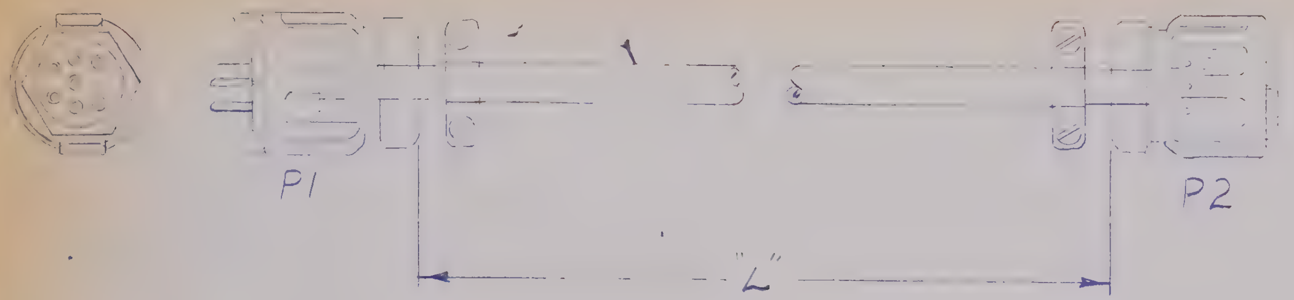
REVISIONS

SCALE Full | FIRST USED ON 2990-9174
DR. ARG | CH. CCM | APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1094 | ISSUE 1

ESMP-30-.250



LEAKAGE SUPPLY CABLE ASM
2994-1095

PART NO.	"L"	P1	P2
2994-1095	8FT	4220-5402	4220-5406
2994-1079	18IN.	4220-5402	4220-5406

CONSTRUCT CABLE USING ESMW-5-2-24

P1	WIRE	P2
A	BU	A
B	GN	B
C	RD	C
D	VT	D
E	OR	E
F	YE	F
H	GY	H

NUMBER	ISSUE
2994-1095	/2

DATE: 9-12-69	ISSUE 1
REVISIONS	
2994-1095 WAS 2994-1078 ARG 25 SEPT 69 ARG	Z

SCALE Full	FIRST USED ON 2990-9174	
DR. JPJ	CH.	APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

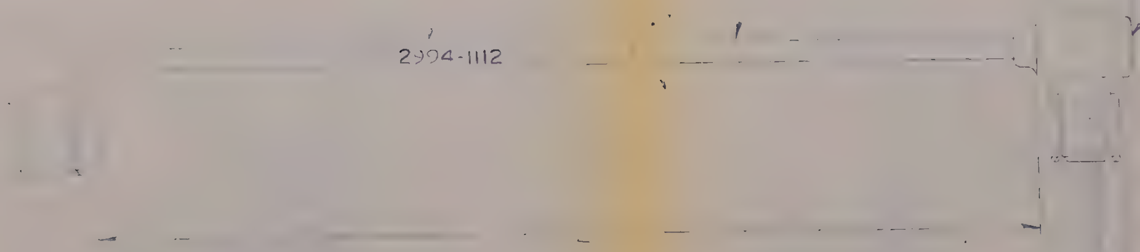
NUMBER	ISSUE
2994-1095	/2

2994-1112

3-[illegible]

REVISIONS

~~TRIAL LOT WRAP~~



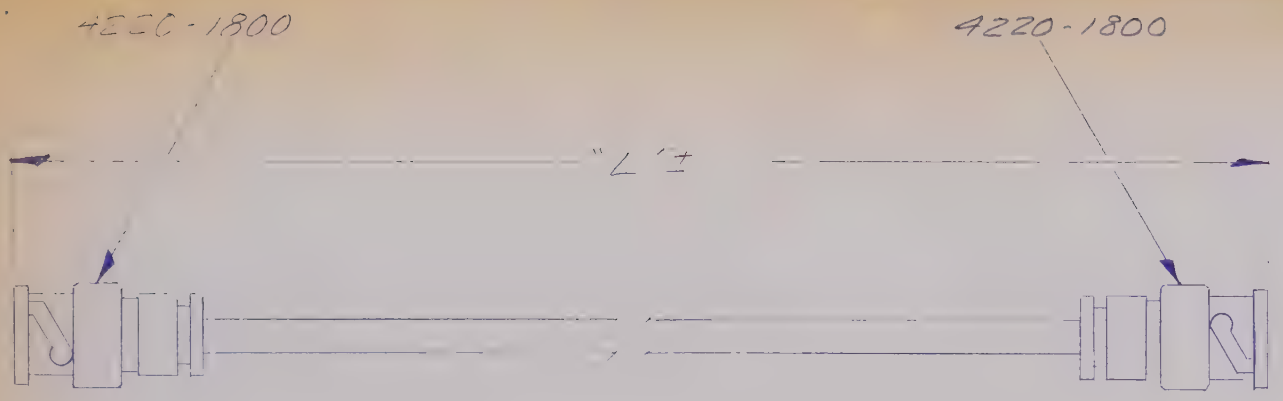
MOLDED CONN. [illegible]
REL [illegible]
BOTH ENDS

ELEC. BREAKDOWN CHECK 1000VRMS MA
CONTINUITY, LEAKAGE @ 500V > 10C

[illegible]				[illegible] LENGTH [illegible] SER. [illegible]
2994-1112	PATCH CORD	2994-1112	18 ±1"	20 ±1"

FULL | FIRST USED ON
DR Beh | CH | APP
GENERAL RADIO COMPAN
W CONCORD MASS USA

2994-1112



ESMW-26-2
SERVICE & ASM PER ZZWIS-14U DWG.

CABLE ASM

CABLE NUMBER	LENGTH "L"
2994-1114	4 FT
2994-1115	5 FT
2994-1118	8 FT
2994-1119	9 FT

NUMBER 2994-1114 ISSUE 1

DATE: 1 NOV 69 ISSUE 1

REVISIONS

SCALE Full
FIRST USED ON 2990-9174
DR. ARG
CH.
APP.

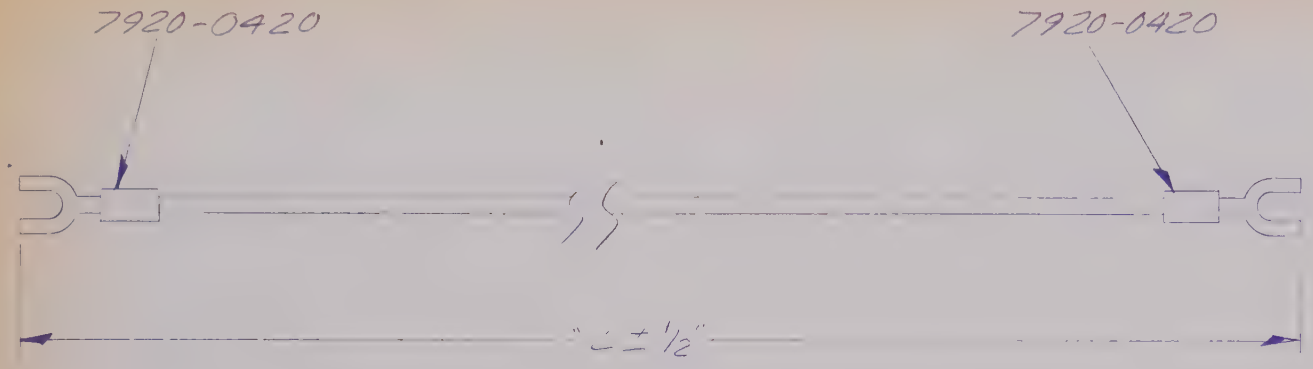
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1114 ISSUE 1

NUMBER 2994-118 ISSUE 1

DATE: 1 NOV 69 ISSUE 1

REVISIONS



TERMINAL & LEAD ASM

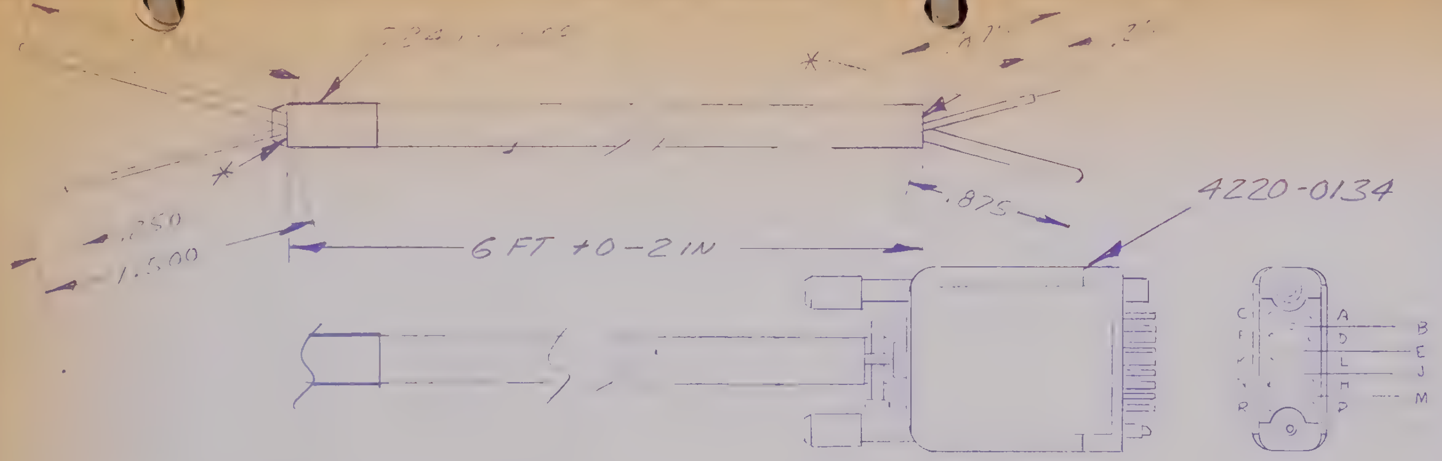
SERVICE ENDS .375, ATTACH TERMINALS
& CRIMP.

PART NUMBER	LENGTH L	WIRE
2994-1180	8"	ESMW-S-2L-20 BK
2994-1181	8"	ESMW-S-2L-20, WH-RD-BR-BK
2994-1182	3	ESMW-S-2L-20, BK

SCALE Full
FIRST USED ON 2994-1175
DR. APG
CH.
APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1180 ISSUE 1



4220-0134
6 FT +0-2 IN
.875
.250
1.500
*
A
B
C
D
E
F
H
J
L
M
P
R

USE ESMW-89.
CUT OF LEADS NOT USED AT *

NUMBER 2995-9197-2	ISSUE 1
DATE: 24 SEPT 67	ISSUE 1

REVISIONS

SCALE Full	FIRST USED ON	
DR. ARG	CH.	APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2995-9197-12	ISSUE 1

NUMBER	ISSUE
2994-1183	1

ISSUE	DATE
1	3 NOV 69

REVISIONS

SCALE Full

FIRST USED ON 2990-7174

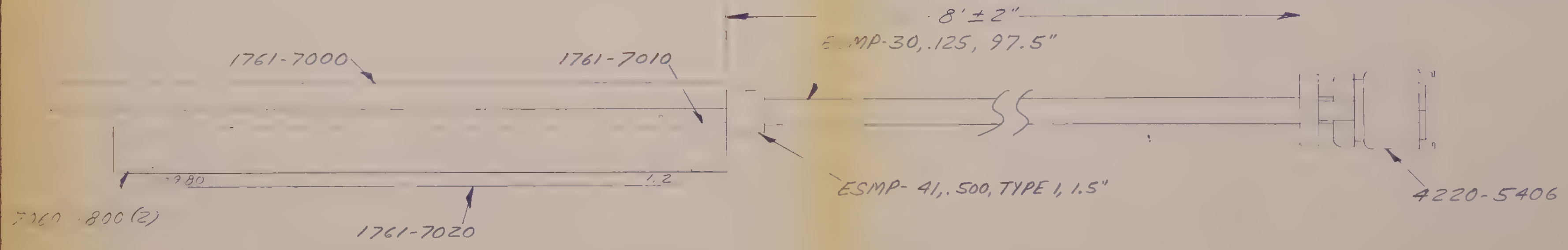
DR.

CH.

APP

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1183 ISSUE 1


8' ± 2"
ESMP-30, .125, 97.5"
1761-7000
1761-7010
.280
1.2
1760-800(2)
1761-7020
ESMP- 41, .500, TYPE 1, 1.5"
4220-5406

SERVICE LEADS THIS END .250

SERVICE LEADS THIS END .125

LE[illegible] RANGE CABLE ASM.
2994-1183
USE ESMW-5-2L-24 WIRE

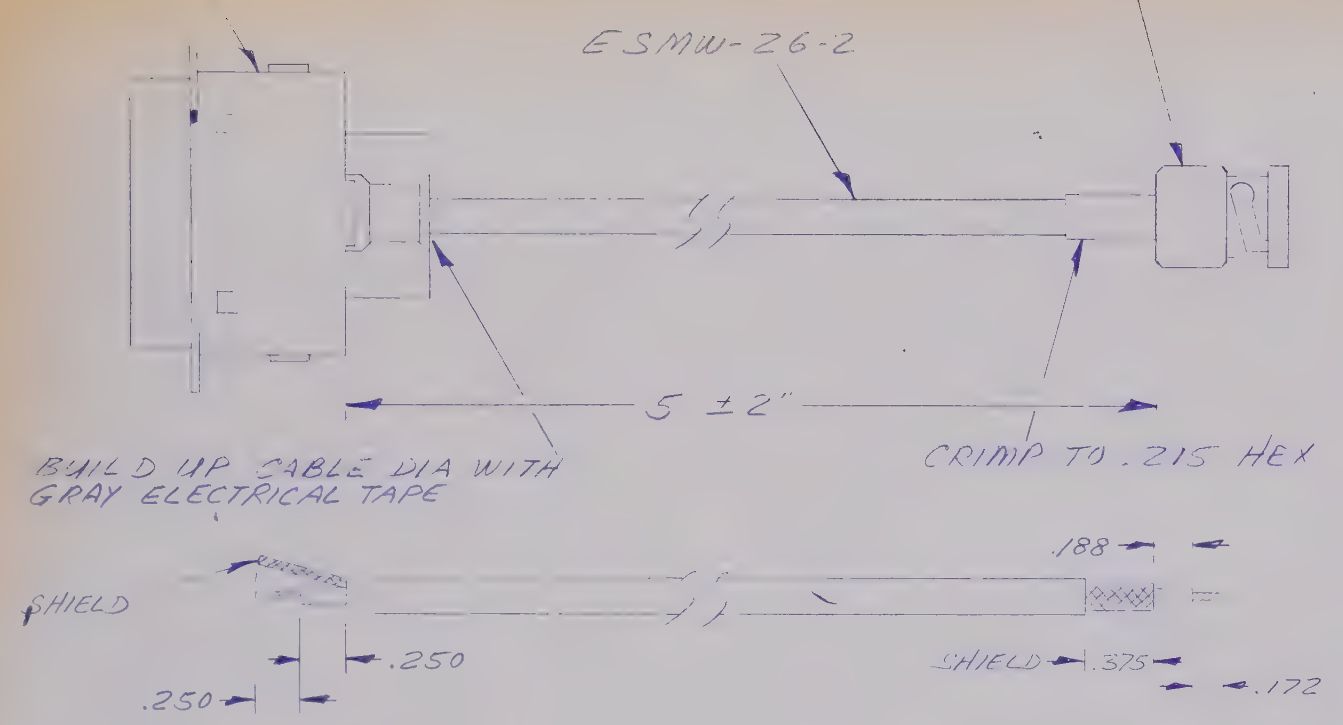
1761 CONNECTOR	WIRE COLOR	4220-5406 CONNECTOR
PIN 12	BR	PIN H
14	RD	C
16	[illegible]	F
18	GY	B
78, 80	OR	A

NUMBER 2994-1184 ISSUE 1A

DATE: 3 NOV 69 ISSUE 1

REVISIONS

REVISED PER MRD RECORD CCH 1-16-70	1A



ESMW-26-2
5 ± 2"
BUILD UP CABLE DIA WITH GRAY ELECTRICAL TAPE
CRIMP TO .215 HEX
.188
SHIELD
.250
.250
SHIELD
.375
.172

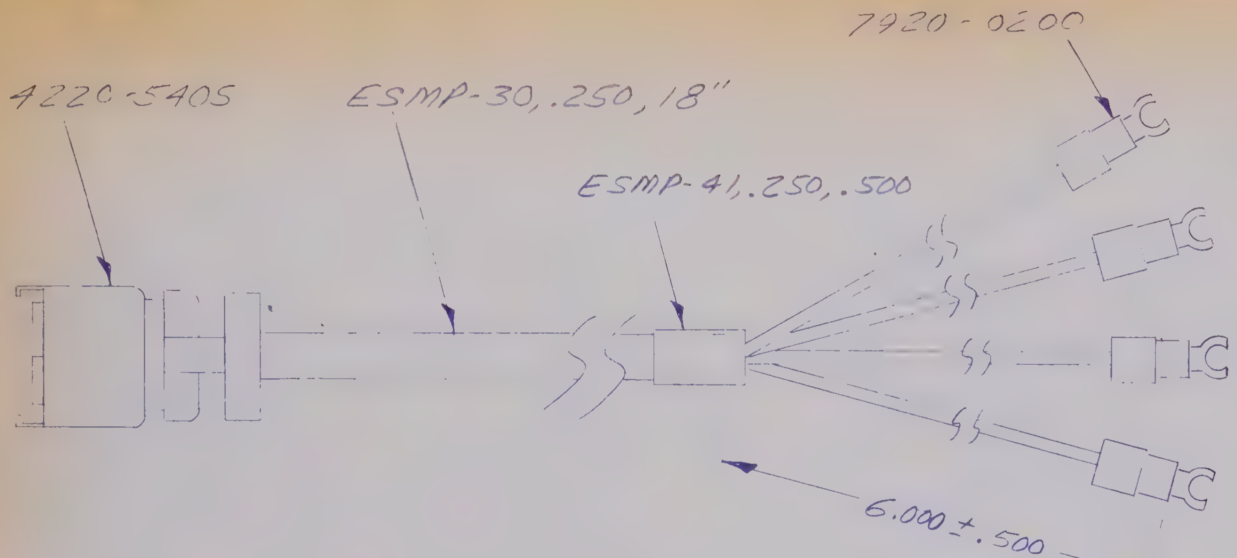
THIS END
CENTER CONDUCTOR TO PIN 1
SHIELD TO PIN 13

DISPLAY HV CABLE ASM.
2994-1184

SCALE Full FIRST USED ON 2990-9174
DR. ARG CH. APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1184 ISSUE 1A


7920-0200
4220-5405
ESMP-30,.250,18"
ESMP-41,.250,.500
6.000 ± .500

SERVICE LEADS THIS END .250

SERVICE LEADS THIS END .375

USE ESMW-5-2-16 WIRE

HV REMOTE CABLE ASM
2994-1185

4220-5405 CONNECTOR PIN	WIRE COLOR
A	WH-BK
B	WH-BR
D	NH-GN
E	WH-BU

NUMBER 2994-1185 ISSUE 1A

DATE: 4-NOV 69 ISSUE 1

REVISIONS

REVISED PER MKD RECORD CCH 1-1 7-70 PAJ	1A

SCALE Full FIRST USED ON 2990 1174

DR. ARG CH. APP.

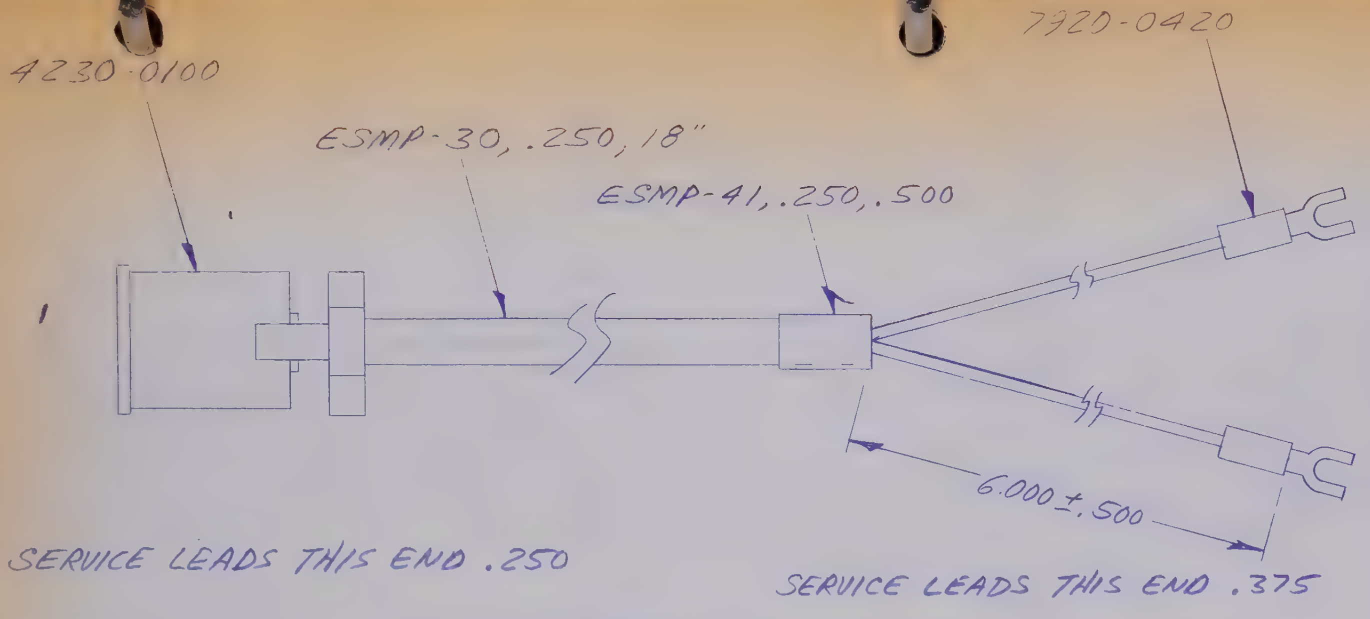
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1185 ISSUE 1A

NUMBER	ISSUE
2994-118	1

DATE: 4 NOV 69 ISSUE 1

REVISIONS


4230-0100
ESMP-30, .250, 18"
ESMP-41, .250, .500
7920-0420
6.000 ± .500

SERVICE LEADS THIS END .250

SERVICE LEADS THIS END .375

USE ESMW-S-2-20 WIRE

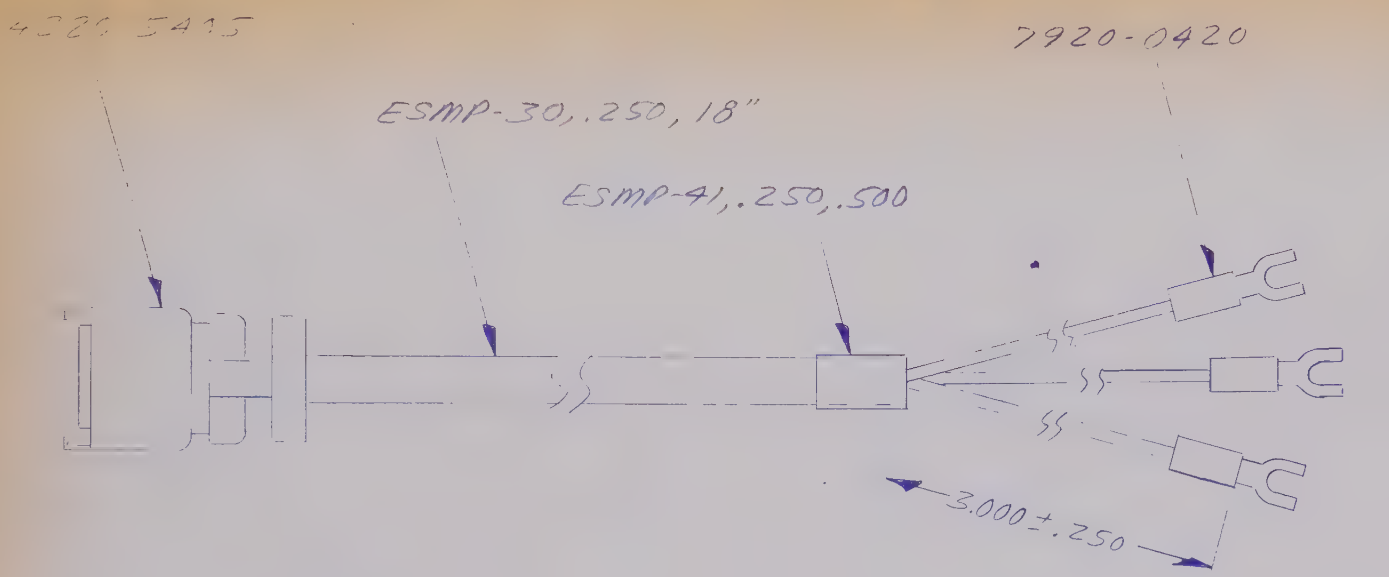
HV RELAY CONTROL CABLE ASM.
2994-1186

4230-0100 CONNECTOR PIN	WIRE COLOR
2	WH-YE-OR
4	WH-YE-VT

SCALE Full	FIRST USED ON 2990-9174
DR. ARG	CH. CCW
APP.	

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER	ISSUE
2994-1186	1


4220 5405
ESMP-30,.250, 18"
ESMP-41,.250,.500
7920-0420
3.000±.250

SERVICE LEADS THIS END .250

SERVICE LEADS THIS END. 375

USE ESMW-S-2-20 WIRE

HV INPUT CABLE ASM.
2994-1187

4220-5405 CONNECTOR PIN	WIRE COLOR
B	WH-YE-BK
D	WH-YE-RD
E	BK

NUMBER 2994-1187	ISSUE 2
DATE: 4 NOV 67	ISSUE 1

REVISIONS

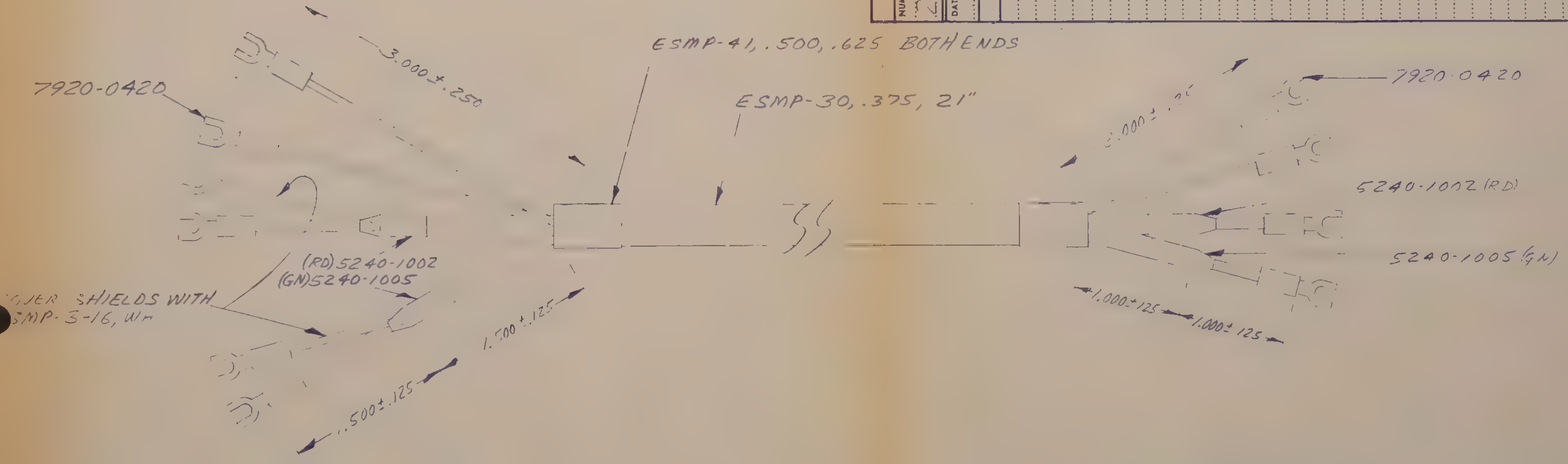
CHANGED PER MKD. RECORD CCH 1-17-70 PN	2

SCALE Full	FIRST USED ON 2990-9174	
DR. ARG	CH.	APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1187 ISSUE 2

NUMBER 2994-1188
ISSUE 1
DATE 4 MAY 62
REVISIONS
SCALE
FIRST USED ON 2990-7.74
DR. AKS
CH.
APP
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.
NUMBER 2994-1188
ISSUE 1



ESMP-41, .500, .625 BOTH ENDS
ESMP-30, .375, 21"
7920-0420
3.000 ± .250
(RD) 5240-1002
(GN) 5240-1005
…ER SHIELDS WITH
…SMP-3-16, WH
1.500 ± .125
1.500 ± .125
7920-0420
3.000 ± .2…
5240-1002 (RD)
5240-1005 (GN)
1.000 ± .125
1.000 ± .125

SERVICE LEADS THIS END .375

SERVICE LEADS THIS END .375

KEPCO INTERFACE CABLE ASM.
2994-1188

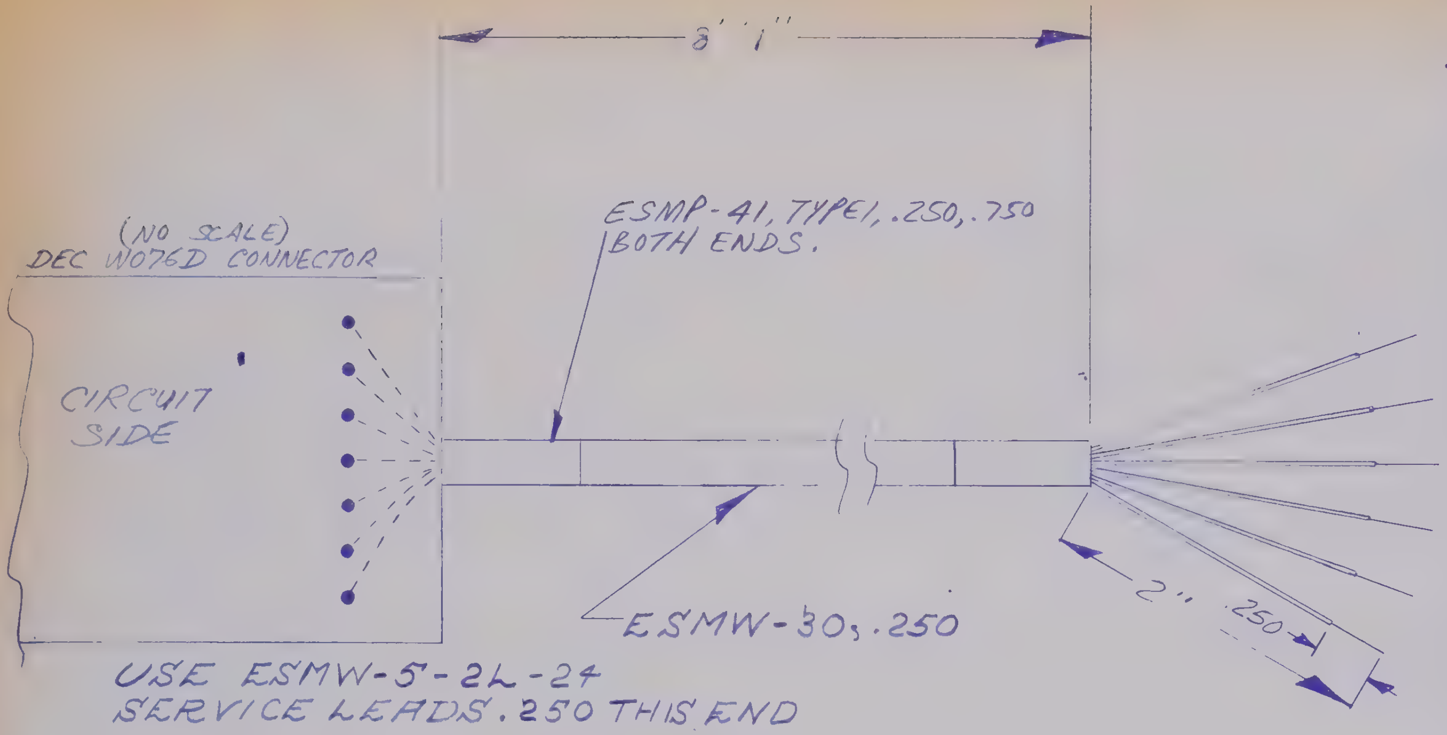
WIRE	LENGTH	NO REQ'D
ESMW-99	26	2
ESMW-5-2-20, BK	26	1
ESMW-5-2-20, BK	26	1

2994-1189 1A

DATE: 10-2-69 ISSUE 1

REVISIONS

14 PIN CONNECTIONS ADDED 1A
ARG 12 JAN 70


8' 1"
ESMP-41, TYPE1, .250, .750
BOTH ENDS.
(NO SCALE)
DEC W076D CONNECTOR
CIRCUIT
SIDE
ESMW-30, .250
2"
.250

USE ESMW-5-2L-24
SERVICE LEADS .250 THIS END

PIN #	COLOR	14 PIN CONN. CONNECTIONS
-RELAY	BU	1
6	WH-YE	3
7	BK	5
+RELAY	WH-OR	7
4	RD	9
3	GY	11

TTY CABL
2994-1189

SCALE ~ FIRST USED ON 2990-9174
DR. ARG CH. APP.

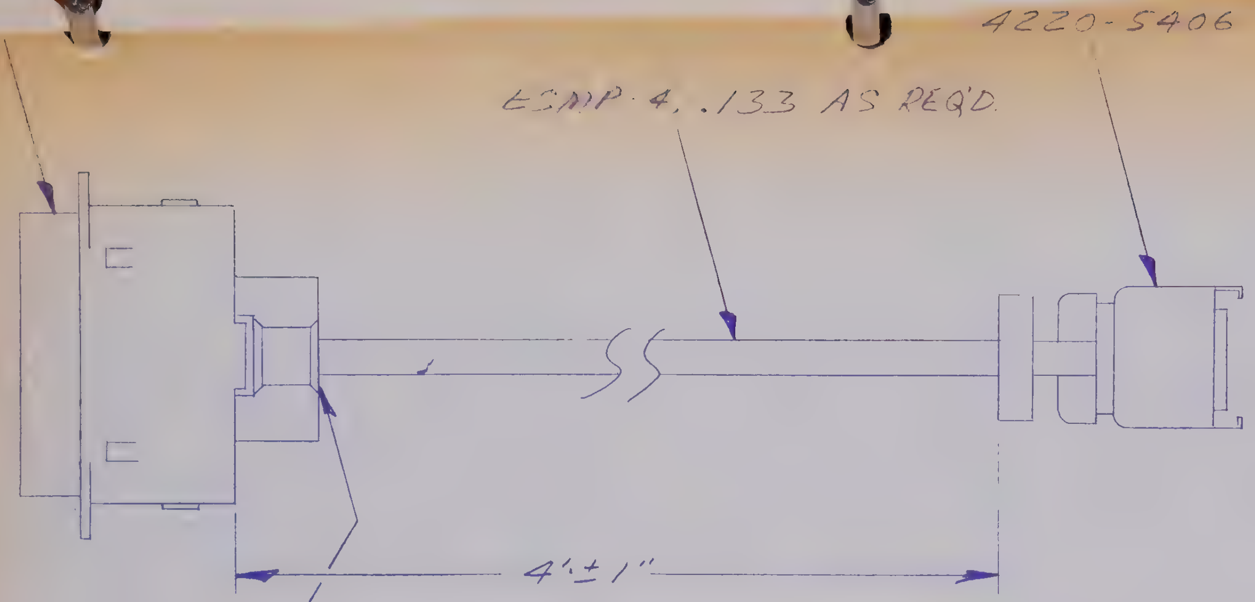
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994 1189 ISSUE 1A

2994-119 /

DATE: 10 NOV 62 ISSUE 1

REVISIONS



BUILD UP CABLE DIA
WITH GRAY ELECTRICAL
TAPE, BOTH ENDS.

USE ESMW-S-2L-24 WIRE.
SERVICE LEADS .250 BOTH ENDS.

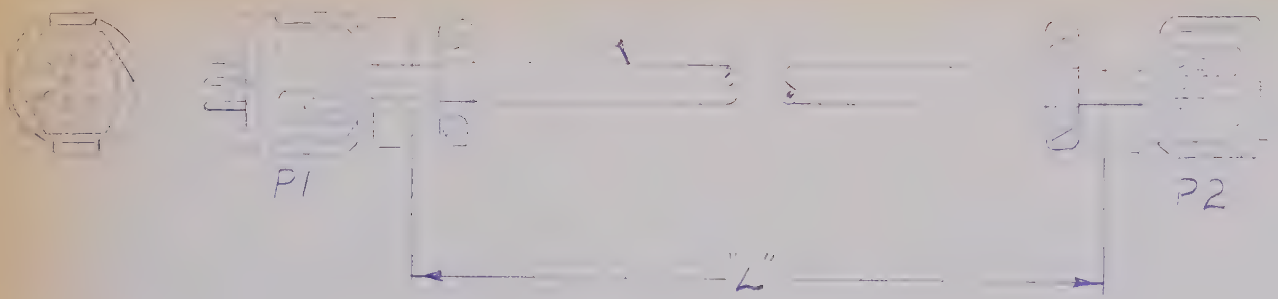
INTERLOCK CABLE ASM.
2994-1190

4220-3024 CONNECTOR	WIRE COLOR	4220-5406 CONNECTOR
PIN 1	WH-YE-RD-BK	PIN E
12	WH-YE-BR	D

SCALE Full | FIRST USED ON 2990-2174
DR. ARG | CH. CCW | APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1190 ISSUE 1



LEAKAGE SUPPLY CABLE ASM
2994-1095

PART NO.	L	P1	P2
2994-1095	8FT.	4220-5402	4220-5406
2994-1079	18IN.	4220-5402	4220-5406

CONSTRUCT CABLE USING ESMW-5-2-24

P1	WIRE	P2
A	BU	A
B	GN	B
C	RD	C
D	VT	D
E	OR	E
F	YE	F
H	GY	H

NUMBER 2994-1095 / 2

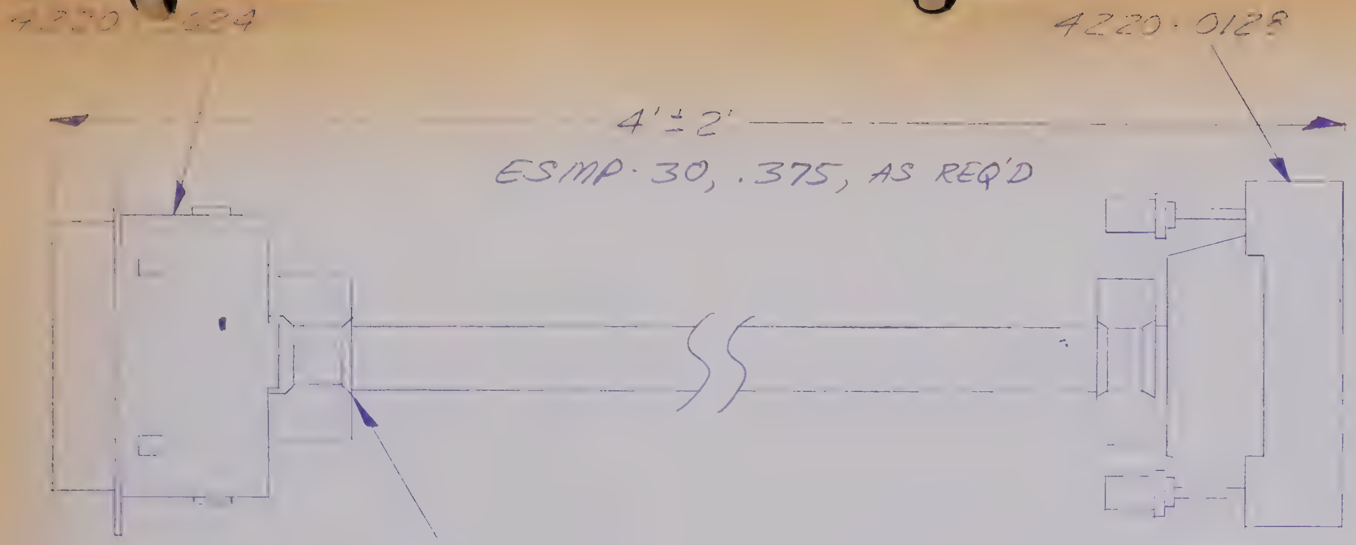
DATE: 9-12-69 | ISSUE 1

REVISIONS	
2994-1095 WAS 2994-1078 ARG 25 SEPT 69 APG	2

SCALE Full	FIRST USED ON 2990-9174	
DR. JPJ	CH.	APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1095 ISSUE / 2



BUILD UP CABLE DIA
WITH GRAY ELECTRICAL
TAPE, BOTH ENDS.

CONTROL RELAY CABLE ASM.
2994-1116

USE ESMW-5-2-24. SERVICE ENDS 1/8.

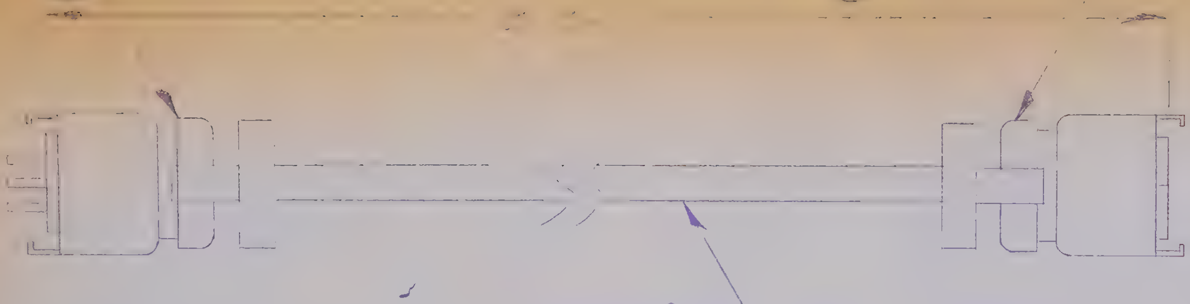
4220-3024 PIN NO.	COLOR	4220-0128 PIN NO
1	BK	C12
2	BR	A12
3	RD	A8
7	OR	B7
9	YE	D9
11	GN	C8
12	BU	H7
13	VT	F7
14	GY	D7
15	WH BK	E3
17	WH BR	E7

DATE: 1 NOV 69	ISSUE 1
REVISIONS	

SCALE Full	FIRST USED ON 2990-9174
DR. ARG	CH. CAL
APP.	

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1116
ISSUE 1



BUILD UP CABLE DIA
WITH GRAY ELECTRICAL
TAPE, BOTH ENDS

HV INPUT CABLE ASM.
2994-1117

USE ESMW-5-2-20. SERVICE ENDS 1/8.

4220-5401 PIN	COLOR	4220-5405 PIN
B	WH-GN-BR-BK	E
D	WH-RD-BR-BK	A
E	BK	D

NUMBER 2994-1117

DATE 1 [illegible] 68 ISSUE 1

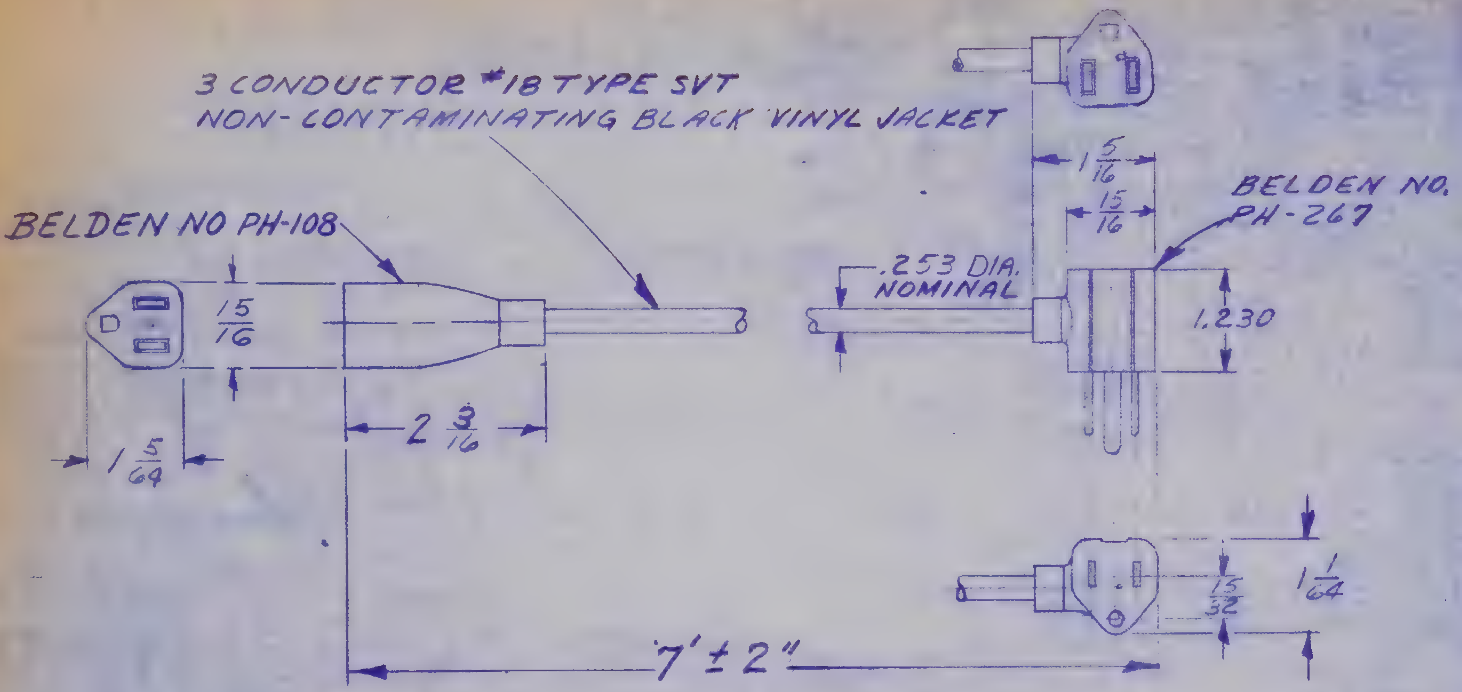
REVISIONS

SCALE Full
FIRST USED ON [illegible]
DR. AKG
CH. [illegible]
APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1117
ISSUE 1

PREFERRED


3 CONDUCTOR #18 TYPE SVT
NON-CONTAMINATING BLACK VINYL JACKET
BELDEN NO PH-108
15/16
1 5/64
2 3/16
.253 DIA. NOMINAL
1 5/16
15/16
BELDEN NO. PH-267
1.230
15/32
1 1/64
7' ± 2"

RECEPTACLE & CAP TO BE MOLDED OF VINYL & IN CONFORMANCE WITH ASA-C73.11-1963 OR LATEST REVISION

TOLERANCE UNLESS OTHERWISE SPECIFIED:
FRACTIONAL DIMENSIONS = ± 1/64

NUMBER 4200-9622	ISSUE /
DATE: 10-4-60	ISSUE 1
REVISIONS	
"BELDEN NO. DXP-1380-A" REMOVED, .163 WAS 1/8, 1.200 WAS 1 1/8, .031 WAS .030, 1/8 WAS 3/16, 41/64 WAS 5/8 PER MARKED RECORD HCL 12-21-60	2
1/4 R(2) & 5/64 R ADDED HCL 4-29-61	3
PLUG REVISED PER MARKED RECORD HCL/CM 4-2-64 5-26-64 RFD	4
BELDEN NO. "PH-267" WAS "DXP-2506-A" PER MARKED RECORD HCL 9-3-64 RFD	5
".253 DIA. NOMINAL" WAS ".260 DIA. NOMINAL" HCL/CM 10-6-64 10-27-64 RFD	6
DIMS. & NOTES REVISED PER MARKED RECORD JHN 6-4-65 LXC	7
DWG. NO. WAS CAP-1J. ALPHA-NUMERIC TO NUMERIC SYSTEM PER MARKED RECORD ARG 9-19-66	8

SCALE 1/2:1 FIRST USED ON
DR. J.E.N CH. APP. H.C.L

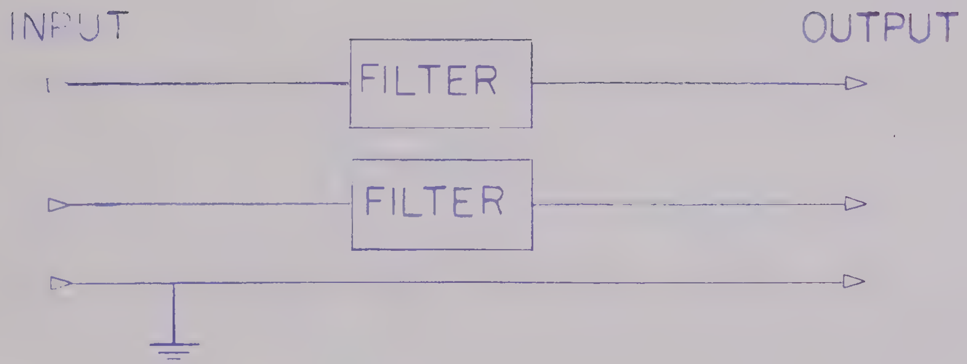
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

PARTS LIST DESCRIPTION
CABLE, POWER

CLASS

CABLE, POWER

NUMBER 4200-9622 ISSUE /8


INPUT
FILTER
FILTER
OUTPUT

2995-1[illegible]0-2D/

DATE: 1/17/75

ISSUE 1

REVISIONS

SCALE -

FIRST USED ON

DR. CLW

CH.

APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2995-1100-2D/1

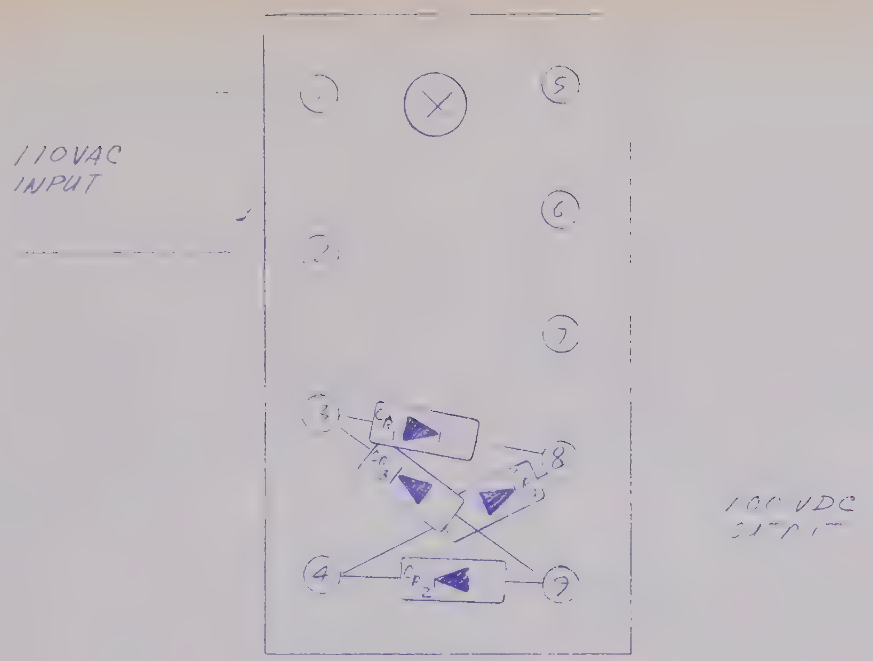
ISSUE

0745-90[illegible]

DATE: 13 [illegible] 62

ISSUE 1

REVISIONS


110VAC
INPUT
1
2
3
4
5
6
7
8
9
CR1
CR2
CR3
CR4
100 VDC
OUTPUT

TOP VIEW

TRANSFORMER ASM
0745-9000

ASM 6081-1002 (4) TO TRANSFORMER TERMINALS
AS SHOWN

SCALE 2 X
FIRST USED ON 2115 [illegible]
DR. [illegible]
CH.
APP.

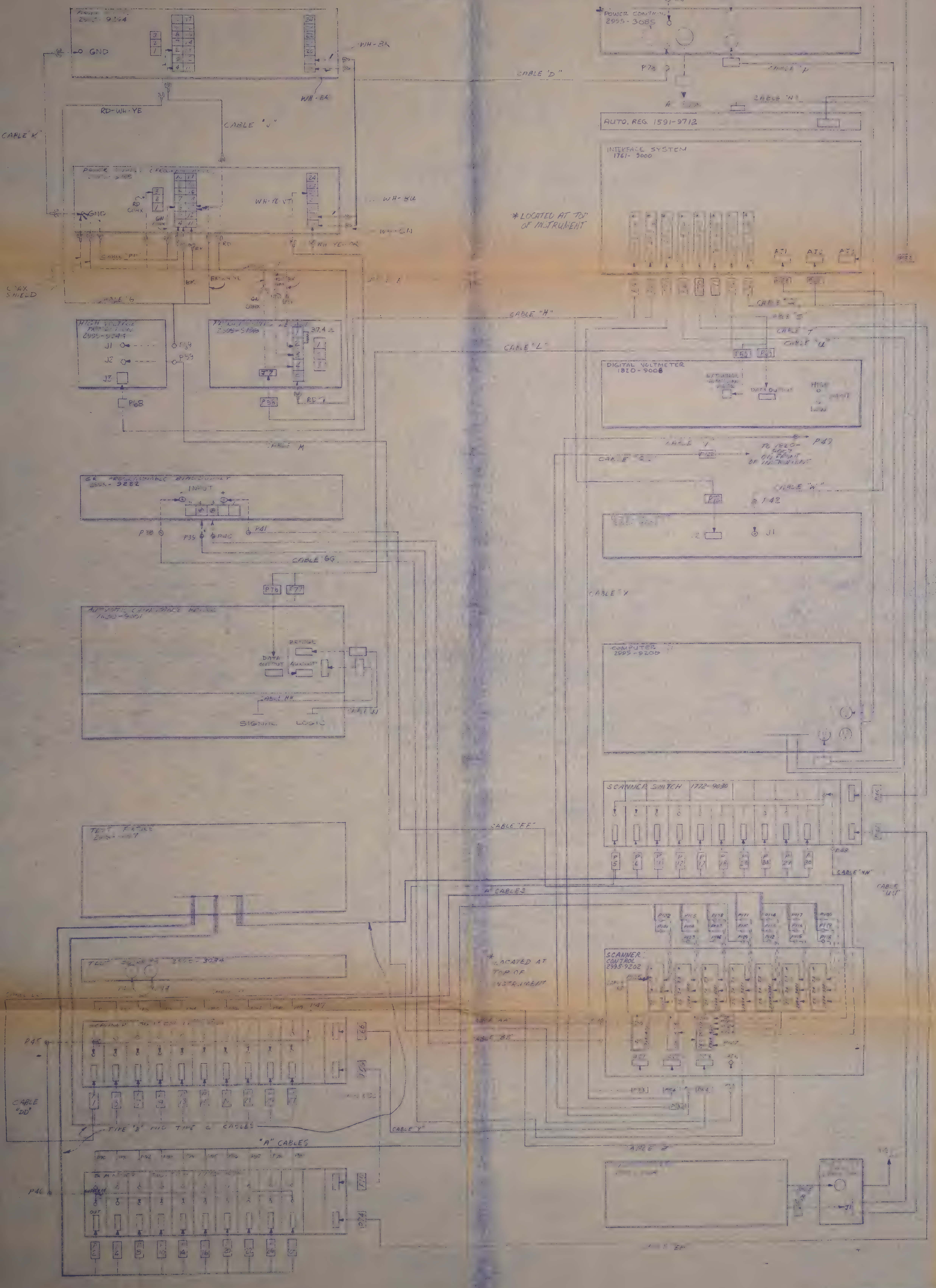
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 0745-9002-12
ISSUE 1

AUTOMATIC CAPACITOR TESTING SYSTEM

2990 - 9174

REAR VIEW INTERCONNECTIONS

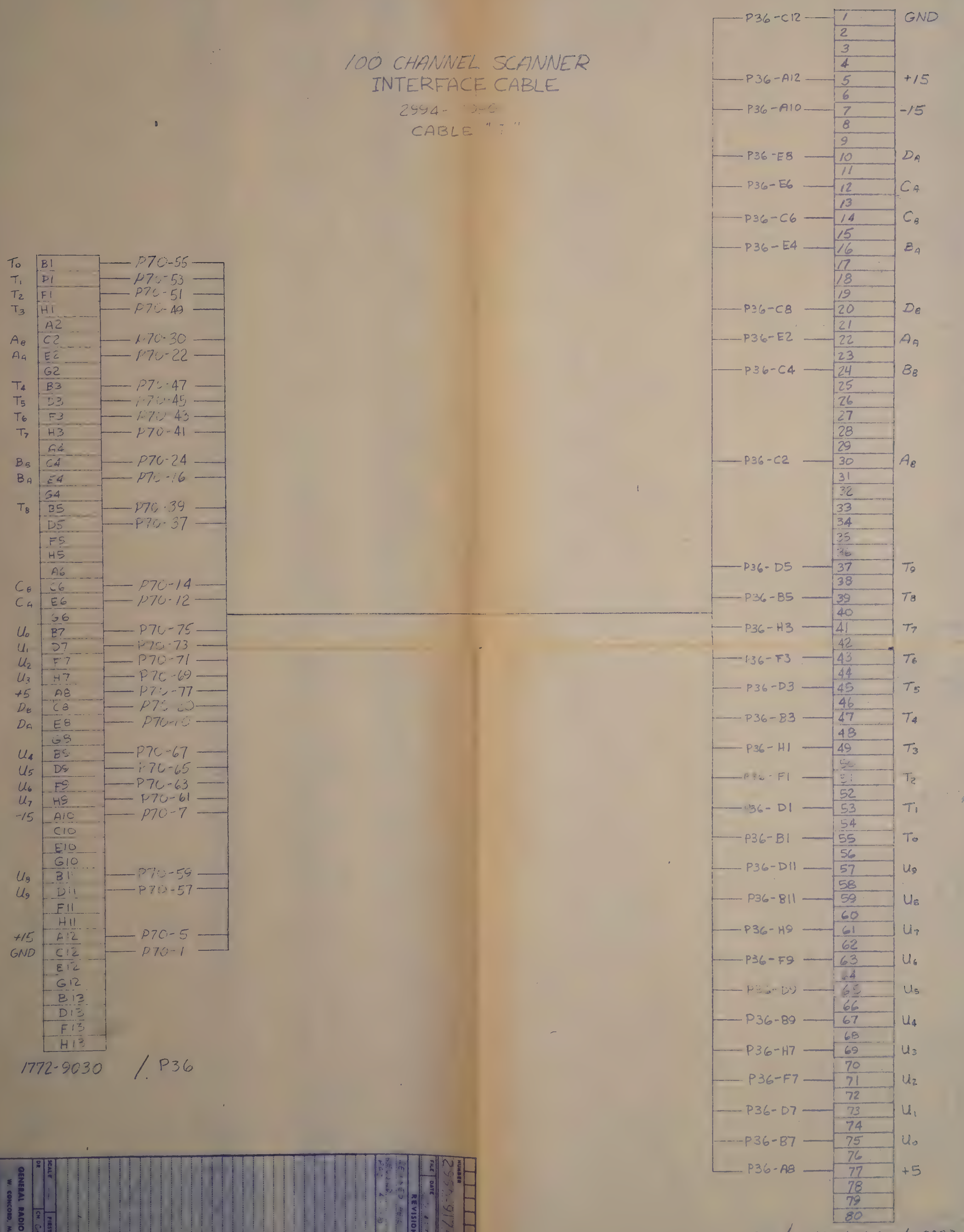

CABLE "MM"
POWER CONTROL 2995-3085
P78
CABLE "P"
CABLE "N"
AUTO. REG. 1591-9712
INTERFACE SYSTEM 1761-9000
*LOCATED AT TOP OF INSTRUMENT
AJ1
AJ2
AJ3
CABLE "S"
CABLE "T"
CABLE "U"
CABLE "H"
CABLE "L"
DIGITAL VOLTMETER 1820-9008
DATA OUTPUT
HIGH
INPUT
LOW
CABLE "V"
CABLE "Z"
TO RECORDER ON FRONT OF INSTRUMENT
P43
CABLE "W"
P42
J1
J2
CABLE "X"
COMPUTER 2995-9200
SCANNER SWITCH 1772-9030
P5
P6
P11
P12
P17
P18
P23
P24
P29
P30
P48
CABLE "NN"
CABLE "UU"
"A" CABLES
SCANNER CONTROL 2995-9202
*LOCATED AT TOP OF INSTRUMENT
CABLE "AA"
CABLE "BB"
CABLE "EE"
CABLE "FF"
CABLE "Y"
CABLE "D"
POWER 2995-9264
GND
WH-BK
RD-WH-YE
CABLE "J"
CABLE "K"
POWER SUPPLY
WH-YE VT
WH-BU
WH-GN
RD
GN
COAX
BK
BROWN YE
CABLE "G"
COAX SHIELD
HIGH VOLTAGE 2995-9247
J1
J2
J3
P68
P59
P56
374.2
CABLE "M"
GR PROGRAMMABLE 2995-9282
INPUT
P38
P39
P40
P41
CABLE "GG"
P76
P77
AUTOMATIC CAPACITANCE BRIDGE 1680-9001
BRIDGE
DATA OUTPUT
SIGNAL
LOGIC
CABLE "HH"
TEST FIXTURE
TEST 2995-3084
P47
P45
P46
CABLE "DD"
TYPE "B" AND TYPE "C" CABLES
"A" CABLES
OUT
CABLE "EE"

SCALE —
FIRST USED ON
DR
CK
APP
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.
NUMBER
ISSUE

100 CHANNEL SCANNER INTERFACE CABLE

2994- [illegible]

CABLE "T"



1772-9030 / P36

Signal	P36	P70
T_0	B1	P70-55
T_1	D1	P70-53
T_2	F1	P70-51
T_3	H1	P70-49
	A2	
A_8	C2	P70-30
A_4	E2	P70-22
	G2	
T_4	B3	P70-47
T_5	D3	P70-45
T_6	F3	P70-43
T_7	H3	P70-41
	A4	
B_8	C4	P70-24
B_4	E4	P70-16
	G4	
T_8	B5	P70-39
	D5	P70-37
	F5	
	H5	
	A6	
C_8	C6	P70-14
C_4	E6	P70-12
	G6	
U_0	B7	P70-75
U_1	D7	P70-73
U_2	F7	P70-71
U_3	H7	P70-69
+5	A8	P70-77
D_8	C8	P70-20
D_4	E8	P70-10
	G8	
U_4	B9	P70-67
U_5	D9	P70-65
U_6	F9	P70-63
U_7	H9	P70-61
-15	A10	P70-7
	C10	
	E10	
	G10	
U_8	B11	P70-59
U_9	D11	P70-57
	F11	
	H11	
+15	A12	P70-5
GND	C12	P70-1
	E12	
	G12	
	B13	
	D13	
	F13	
	H13	

P70/ 1761-4745 I/O CARD
PART OF
1761-9000 I/O BOX

P36	P70	Signal
P36-C12	1	GND
	2	
	3	
	4	
P36-A12	5	+15
	6	
P36-A10	7	-15
	8	
	9	
P36-E8	10	D_4
	11	
P36-E6	12	C_4
	13	
P36-C6	14	C_8
	15	
P36-E4	16	B_4
	17	
	18	
	19	
P36-C8	20	D_8
	21	
P36-E2	22	A_4
	23	
P36-C4	24	B_8
	25	
	26	
	27	
	28	
	29	
P36-C2	30	A_8
	31	
	32	
	33	
	34	
	35	
	36	
P36-D5	37	T_9
	38	
P36-B5	39	T_8
	40	
P36-H3	41	T_7
	42	
P36-F3	43	T_6
	44	
P36-D3	45	T_5
	46	
P36-B3	47	T_4
	48	
P36-H1	49	T_3
	50	
P36-F1	51	T_2
	52	
P36-D1	53	T_1
	54	
P36-B1	55	T_0
	56	
P36-D11	57	U_9
	58	
P36-B11	59	U_8
	60	
P36-H9	61	U_7
	62	
P36-F9	63	U_6
	64	
P36-D9	65	U_5
	66	
P36-B9	67	U_4
	68	
P36-H7	69	U_3
	70	
P36-F7	71	U_2
	72	
P36-D7	73	U_1
	74	
P36-B7	75	U_0
	76	
P36-A8	77	+5
	78	
	79	
	80	

10-27-69 P.P.D.

NUMBER 2990-9174-8? ISSUE 2

FILE DATE [illegible] ISSUE 1

REVISIONS

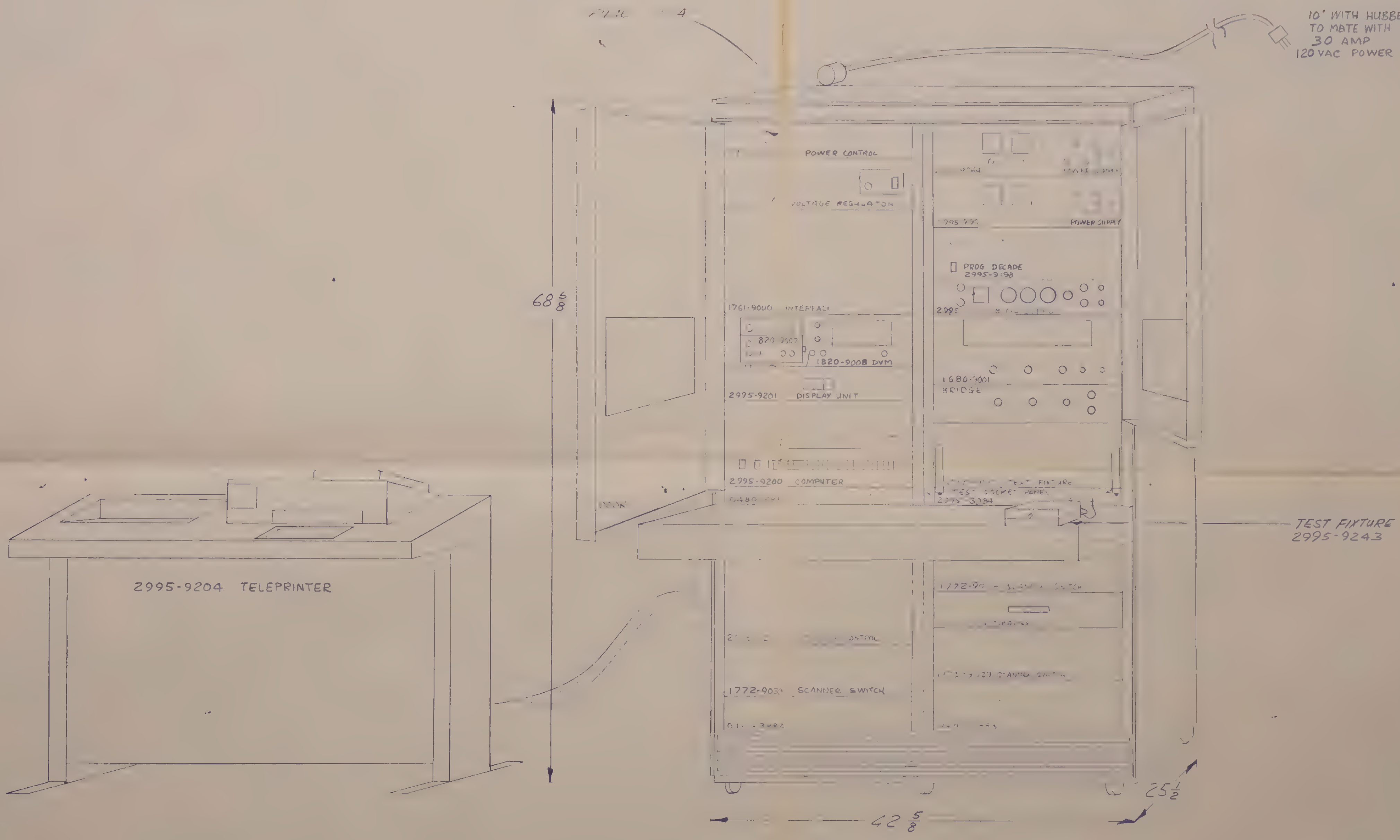
REVISED PER [illegible] 2

SCALE — FIRST USED ON

DR CH. C.H. APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2990-9174-8? ISSUE 2


POWER CONTROL
VOLTAGE REGULATOR
POWER SUPPLY
2995-99[illegible] POWER SUPPLY
PROG DECADE
2995-9198
1761-9000 INTERFACE
1820-9008 DVM
1680-9001
BRIDGE
2995-9201 DISPLAY UNIT
2995-9200 COMPUTER
TEST FIXTURE
TEST SOCKET PANEL
2995-3194
1772-90[illegible] SCANNER SWITCH
1772-9030 SCANNER SWITCH
DOOR
68 5/8
42 5/8
25 1/2
2995-9204 TELEPRINTER

10' WITH HUBBELL TYPE 3331
TO MATE WITH HUB. TYPE 3330
30 AMP
120 VAC POWER

TEST FIXTURE
2995-9243

AUTOMATIC CAPACITOR – TESTING
SYSTEM
2990-9174

NOTE
1. APPROX WEIGHT 1400 LBS INCLUDING
TELEPRINTER.

NUMBER 299[illegible] 1D ISSUE [illegible]
DATE 8-[illegible]-68 ISSUE 1

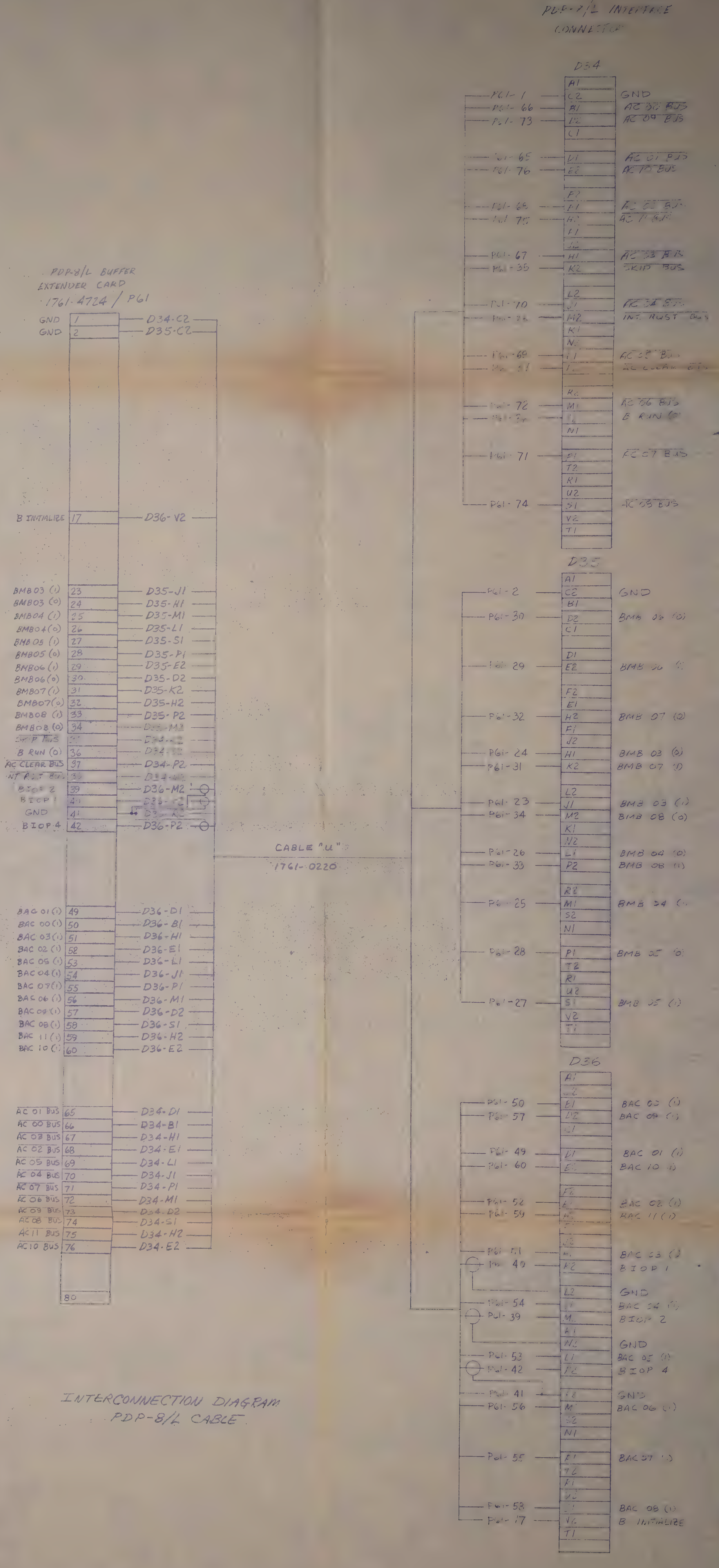
REVISIONS

[illegible]	2
[illegible]	3

SCALE 1/8
FIRST USED ON
DR. ARG
CH
APP

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER [illegible]74-1D ISSUE [illegible]

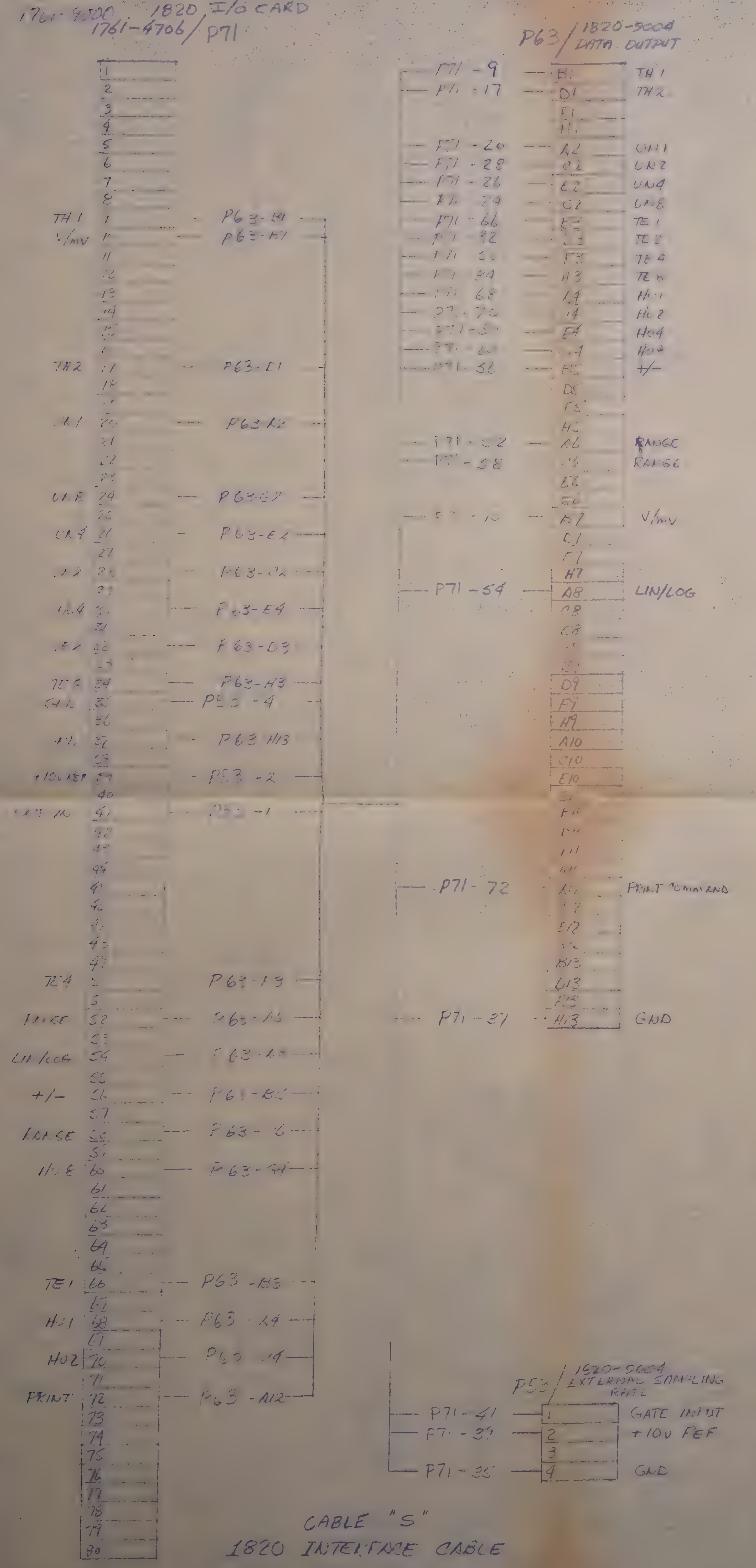

PDP-8/L BUFFER
EXTENDER CARD
1761-4724 / P61
GND 1 D34-C2
GND 2 D35-C2
B INITIALIZE 17 D36-V2
BMB03 (1) 23 D35-J1
BMB03 (0) 24 D35-H1
BMB04 (1) 25 D35-M1
BMB04 (0) 26 D35-L1
BMB05 (1) 27 D35-S1
BMB05 (0) 28 D35-P1
BMB06 (1) 29 D35-E2
BMB06 (0) 30 D35-D2
BMB07 (1) 31 D35-K2
BMB07 (0) 32 D35-H2
BMB08 (1) 33 D35-P2
BMB08 (0) 34 D35-M2
SKIP BUS 35 D34-K2
B RUN (0) 36 D34-S2
AC CLEAR BUS 37 D34-P2
INT RQST BUS 38 D34-M2
BIOP 2 39 D36-M2
BIOP 1 40 D36-K2
GND 41 D36-R2
BIOP 4 42 D36-P2
BAC 01 (1) 49 D36-D1
BAC 00 (1) 50 D36-B1
BAC 03 (1) 51 D36-H1
BAC 02 (1) 52 D36-E1
BAC 05 (1) 53 D36-L1
BAC 04 (1) 54 D36-J1
BAC 07 (1) 55 D36-P1
BAC 06 (1) 56 D36-M1
BAC 09 (1) 57 D36-D2
BAC 08 (1) 58 D36-S1
BAC 11 (1) 59 D36-H2
BAC 10 (1) 60 D36-E2
AC 01 BUS 65 D34-D1
AC 00 BUS 66 D34-B1
AC 03 BUS 67 D34-H1
AC 02 BUS 68 D34-E1
AC 05 BUS 69 D34-L1
AC 04 BUS 70 D34-J1
AC 07 BUS 71 D34-P1
AC 06 BUS 72 D34-M1
AC 09 BUS 73 D34-D2
AC 08 BUS 74 D34-S1
AC 11 BUS 75 D34-H2
AC 10 BUS 76 D34-E2
80
CABLE "U"
1761-0220
PDP-8/L INTERFACE
CONNECTOR
D34
A1
P61-1 C2 GND
P61-66 B1 AC 00 BUS
P61-73 D2 AC 09 BUS
C1
P61-65 D1 AC 01 BUS
P61-76 E2 AC 10 BUS
F2
P61-68 E1 AC 02 BUS
P61-75 H2 AC 11 BUS
F1
J2
P61-67 H1 AC 03 BUS
P61-35 K2 SKIP BUS
L2
P61-70 J1 AC 04 BUS
P61-38 M2 INT. RQST BUS
K1
N2
P61-69 L1 AC 05 BUS
P61-37 P2 AC CLEAR BUS
R2
P61-72 M1 AC 06 BUS
P61-36 S2 B RUN (0)
N1
P61-71 P1 AC 07 BUS
T2
R1
U2
P61-74 S1 AC 08 BUS
V2
T1
D35
A1
P61-2 C2 GND
B1
P61-30 D2 BMB 06 (0)
C1
D1
P61-29 E2 BMB 06 (1)
F2
E1
P61-32 H2 BMB 07 (0)
F1
J2
P61-24 H1 BMB 03 (0)
P61-31 K2 BMB 07 (1)
L2
P61-23 J1 BMB 03 (1)
P61-34 M2 BMB 08 (0)
K1
N2
P61-26 L1 BMB 04 (0)
P61-33 P2 BMB 08 (1)
R2
P61-25 M1 BMB 04 (1)
S2
N1
P61-28 P1 BMB 05 (0)
T2
R1
U2
P61-27 S1 BMB 05 (1)
V2
T1
D36
A1
C2
P61-50 B1 BAC 00 (1)
P61-57 D2 BAC 09 (1)
C1
P61-49 D1 BAC 01 (1)
P61-60 E2 BAC 10 (1)
F2
P61-52 E1 BAC 02 (1)
P61-59 H2 BAC 11 (1)
F1
J2
P61-51 H1 BAC 03 (1)
P61-40 K2 BIOP 1
L2 GND
P61-54 J1 BAC 04 (1)
P61-39 M2 BIOP 2
K1
N2 GND
P61-53 L1 BAC 05 (1)
P61-42 P2 BIOP 4
P61-41 R2 GND
P61-56 M1 BAC 06 (1)
S2
N1
P61-55 P1 BAC 07 (1)
T2
R1
U2
P61-58 S1 BAC 08 (1)
P61-17 V2 B INITIALIZE
T1

INTERCONNECTION DIAGRAM
PDP-8/L CABLE

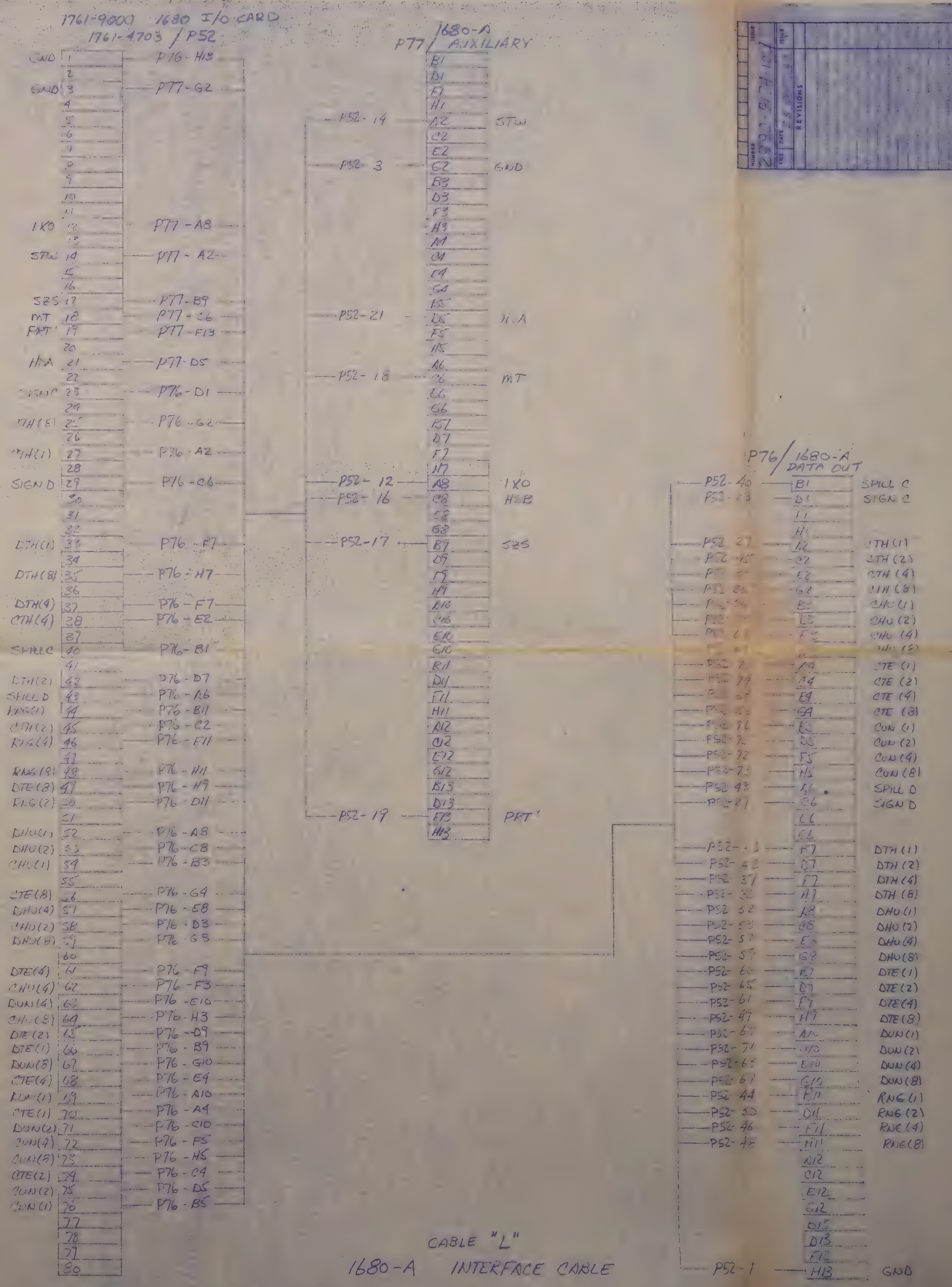
NUMBER		ISSUE
2991-9724-11E		1
FILE	DATE	ISSUE 1
REVISIONS		
SCALE	FIRST USED ON	
DR	CH	APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER ISSUE


1761-9000 1820 I/O CARD
1761-4706 / P71
P63 / 1820-9004 DATA OUTPUT
P53 / 1820-9004 EXTERNAL SAMPLING PANEL
P71 - 41 GATE INPUT
P71 - 39 +10V REF
P71 - 35 GND
PRINT COMMAND
LIN/LOG
RANGE
V/mV
GND

CABLE "S"
1820 INTERFACE CABLE
1761-0222

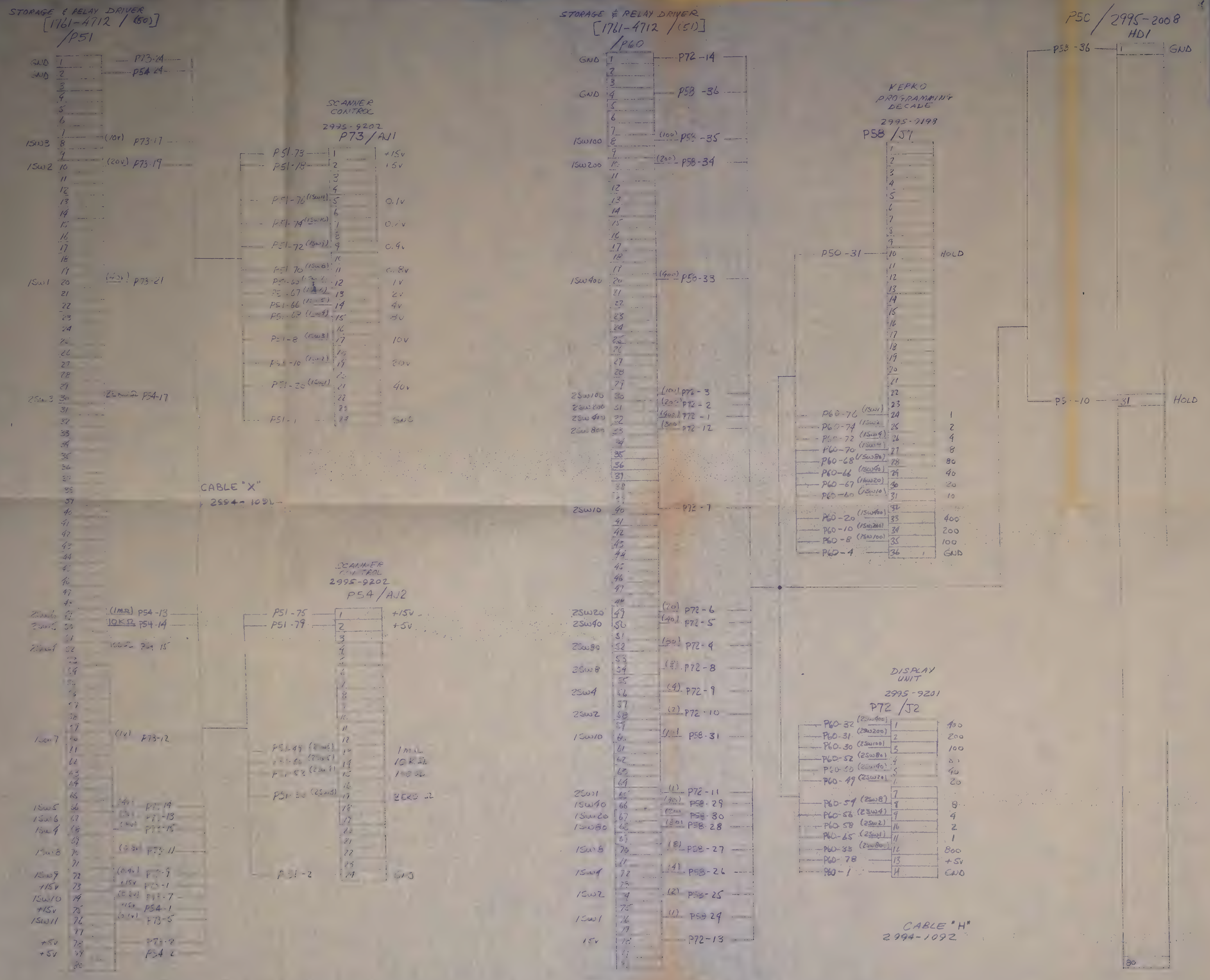

1761-9000 1680 I/O CARD
1761-4703 / P52
P77 / 1680-A AUXILIARY
P76 / 1680-A DATA OUT
STW
GND
H.A
MT
1XO
HSB
S2S
PRT'
SPILL C
SIGN C
SPILL D
SIGN D
GND

CABLE "L"
1680-A INTERFACE CABLE
1761-0221

REVISIONS

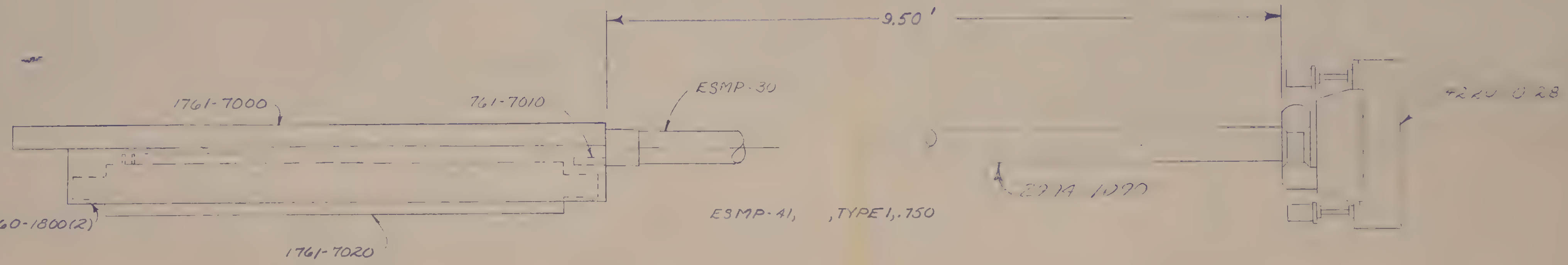
GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

9-2-69


STORAGE & RELAY DRIVER
[1761-4712 / (50)]
/P51
GND 1 — P73-24
GND 2 — P54-24
1SW3 8 (10V) P73-17
1SW2 10 (20V) P73-19
1SW1 20 (40V) P73-21
2SW3 30 ZERO Ω P54-17
2SW6 49 (1MΩ) P54-13
2SW5 50 10KΩ P54-14
2SW4 52 100Ω P54-15
1SW7 60 (1V) P73-12
1SW5 66 (4V) P73-14
1SW6 67 (2V) P73-13
1SW4 68 (8V) P73-15
1SW8 70 (0.8V) P73-11
1SW9 72 (0.4V) P73-9
+15V 73 +15V P73-1
1SW10 74 (0.2V) P73-7
+15V 75 +15V P54-1
1SW11 76 (0.1V) P73-5
+5V 78 P73-2
+5V 79 P54-2
80
SCANNER CONTROL
2995-9202
P73 / AJ1
P51-73 1 +15V
P51-78 2 +5V
P51-76 (1SW11) 5 0.1V
P51-74 (1SW10) 7 0.2V
P51-72 (1SW9) 9 0.4V
P51-70 (1SW8) 11 0.8V
P51-60 (1SW7) 12 1V
P51-67 (1SW6) 13 2V
P51-66 (1SW5) 14 4V
P51-68 (1SW4) 15 8V
P51-8 (1SW3) 17 10V
P51-10 (1SW2) 19 20V
P51-20 (1SW1) 21 40V
P51-1 24 GND
CABLE "X"
2994-1096
SCANNER CONTROL
2995-9202
P54 / AJ2
P51-75 1 +15V
P51-79 2 +5V
P51-49 (2SW6) 13 1MΩ
P51-50 (2SW5) 14 10KΩ
P51-52 (2SW4) 15 100Ω
P51-30 (2SW3) 17 ZERO Ω
P51-2 24 GND
STORAGE & RELAY DRIVER
[1761-4712 / (51)]
/P60
GND 1 — P72-14
GND 4 — P58-36
1SW100 8 (100) P58-35
1SW200 10 (200) P58-34
1SW400 20 (400) P58-33
2SW100 30 (100) P72-3
2SW200 31 (200) P72-2
2SW400 32 (400) P72-1
2SW800 33 (800) P72-12
2SW10 40 P72-7
2SW20 49 (20) P72-6
2SW40 50 (40) P72-5
2SW80 52 (80) P72-4
2SW8 54 (8) P72-8
2SW4 56 (4) P72-9
2SW2 58 (2) P72-10
1SW10 60 (10) P58-31
2SW1 65 (1) P72-11
1SW40 66 (40) P58-29
1SW20 67 (20) P58-30
1SW80 68 (80) P58-28
1SW8 70 (8) P58-27
1SW4 72 (4) P58-26
1SW2 74 (2) P58-25
1SW1 76 (1) P58-24
15V 78 P72-13
KEPKO
PROGRAMMING
DECADE
2995-9198
P58 / J7
P50-31 10 HOLD
P60-76 (1SW1) 24 1
P60-74 (1SW2) 25 2
P60-72 (1SW4) 26 4
P60-70 (1SW8) 27 8
P60-68 (1SW80) 28 80
P60-66 (1SW40) 29 40
P60-67 (1SW20) 30 20
P60-60 (1SW10) 31 10
P60-20 (1SW400) 33 400
P60-10 (1SW200) 34 200
P60-8 (1SW100) 35 100
P60-4 36 GND
DISPLAY UNIT
2995-9201
P72 / J2
P60-32 (2SW400) 1 400
P60-31 (2SW200) 2 200
P60-30 (2SW100) 3 100
P60-52 (2SW80) 4 80
P60-50 (2SW40) 5 40
P60-49 (2SW20) 6 20
P60-54 (2SW8) 8 8
P60-56 (2SW4) 9 4
P60-58 (2SW2) 10 2
P60-65 (2SW1) 11 1
P60-33 (2SW800) 12 800
P60-78 13 +5V
P60-1 14 GND
CABLE "H"
2994-1092
P5C / 2995-2008
HDI
P58-36 1 GND
P5 -10 31 HOLD
80

NUMBER
ISSUE
FILE
DATE
REVISIONS
SCALE
FIRST USED ON
DR
CH
APP.
GENERAL RADIO COMPANY
W CONCORD, MASS. U.S.A.
NUMBER
ISSUE

7-2-61



WIRE TO BE ESMW-5-3-26
UNLESS OTHERWISE SPECIFIED
SERVICE LEADS .187 THIS END

100 CHANNEL SCANNER INTERFACE CABLE ASM.

1761 CONNECTOR		OTHER END		
PIN NO	WIRE COLOR	CONN NO.	PIN NO	S012
[illegible]	BK		GRD	C12
2	BR			
3	BU			
4	GN			
5	RD		+15	A12
6	GY			
7	VT		-15	A10
8	OR			
9	YE			
10	WH		D_6	E8
11	WH BK			
12	WH BR		C_B	E6
13	WH RD			
14	WH GN		C_A	C6
15	WH [illegible]			
16	WH GY		B_B	E4
17	WH VT			
18	WH OR			
19	WH YE			
20	WH [illegible] BK		D_A	C8
21	WH-BU-BK			
22	WH BU-BR		A_B	E2
23	WH GN BK			
24	WH GN BR		B_A	C4
25	WH-GN BU			
26	WH RD-BK			
27	WH RD-BR			

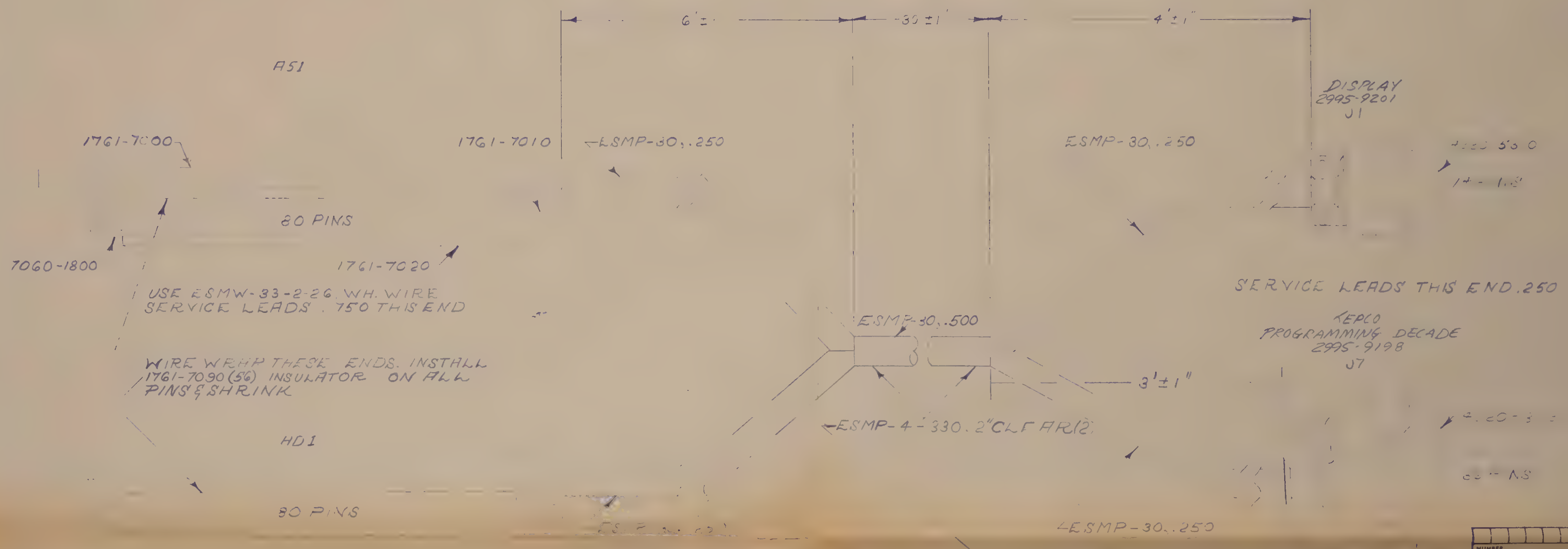
1761 CONNECTOR		OTHER END		
PIN NO	WIRE COLOR	CONN NO	PIN NO	S012
28	WH RD BU			
29	WH RD GN			
30	WH GY BK		A_A	C2
31	WH GY BR			
32	WH-GY-BU			
33	WH GY GN			
34	WH GY RD			
35	WH VT BK			
36	WH [illegible] BK			
37	WH VT BU		T_9	D5
38	WH VT GN			
39	WH-VT-RD		T_8	B5
40	WH VT GY			
41	WH OR BK		T_7	[illegible]
42	WH-OR-BR			
43	WH OR BU		T_6	[illegible]
44	WH OR GN			
45	WH OR RD		T_5	[illegible]
46	WH OR GY			
47	WH OR VT		T_4	[illegible]
48	WH YE BK			
49	WH YE BR		T_3	[illegible]
50	WH YE-BU			
51	WH YE-GN		T_2	F1
52	WH-YE-RD			
53	WH YE GY		T_1	D1
54	WH YE VT			

1761 CONNECTOR		OTHER END		
PIN NO.	WIRE COLOR	CONN NO.	PIN NO	S012
55	WH YE-OR		T_0	B1
56	WH [illegible] BR-BK			
57	WH GN BR-BK		U_9	D11
58	WH-GN BU-BK			
59	WH-GN-BU BR		U_8	B11
60	WH-RD BR BK			
61	WH RD BU BK		U_7	H9
62	WH RD-BU-BR			
63	WH RD-GN-BK		U_6	F9
64	WH RD GN-BR			
65	WH RD GN BU		U_5	D9
66	WH GY BR BK			
67	WH GY BU BK		U_4	B9
68	WH GY-BU BR			
69	WH GY-GN BK		U_3	H1
70	WH GY GN BR			
71	WH GY-GN-BU		U_2	F7
72	WH GY RD-BK			
73	WH GY RD-BR		U_1	[illegible]
74	WH GY RD BU			
75	WH GY-RD GN		U_0	B7
76	WH VT-BR-BK			
77	WH VT BU BK		+5+	A8
78	WH VT-BU-BK			
79	WH [illegible] GN BK			
90	WH [illegible] BR			

NUMBER 2974 1090	ISSUE 11A
DATE 8 3 69	ISSUE
REVISIONS	
DWG NO WAS 1761-7000-1 P.L. NO WAS 1 [illegible] ARG 25 Sept 69 AKG	11A
SCALE F..	FIRST USED ON 761-9001
DR JPJ	CH [illegible]
APP	

GENERAL RADIO COMPANY
W CONCORD, MASS USA

NUMBER 2974 1090 ISSUE 11A


6'±
-30±1"
4'±1"
A51
DISPLAY
2995-9201
J1
1761-7000
1761-7010
ESMP-30,.250
ESMP-30,.250
80 PINS
7060-1800
1761-7020
USE ESMW-33-2-26 WH. WIRE
SERVICE LEADS .750 THIS END
SERVICE LEADS THIS END.250
KEPCO
PROGRAMMING DECADE
2995-9198
J7
ESMP-30,.500
WIRE WRAP THESE ENDS. INSTALL
1761-7090(56) INSULATOR ON ALL
PINS & SHRINK
3'±1"
ESMP-4-330.2"CLEAR(2)
HD1
80 PINS
ESMP-30,.250

NOTE: OVERLAP ESMP-30,.500 [illegible]
.250(2) APPROXIMATELY
TUBING [illegible]
JUNCTION WITH ESMP-4-.330 2 [illegible]

PROGRAMMING & DISPLAY CABLE ASM
2994-1092

A51

PIN	OTHER END
1	J1 14
4	J7 36
8	J7 35
10	J7 34
20	J7 33
30	J1 3
31	J1 2
32	J1 1
33	J1 12
40	J1 7
49	J1 6
50	J1 5
52	J1 4
54	J1 8
56	J1 9
58	J1 10
60	J7 [illegible]
65	J1 [illegible]
66	J7 29
67	J7 30
68	J7 28
70	J7 27
72	J7 26
74	J7 25
7[illegible]	J1 24
78	J[illegible] 3

J1

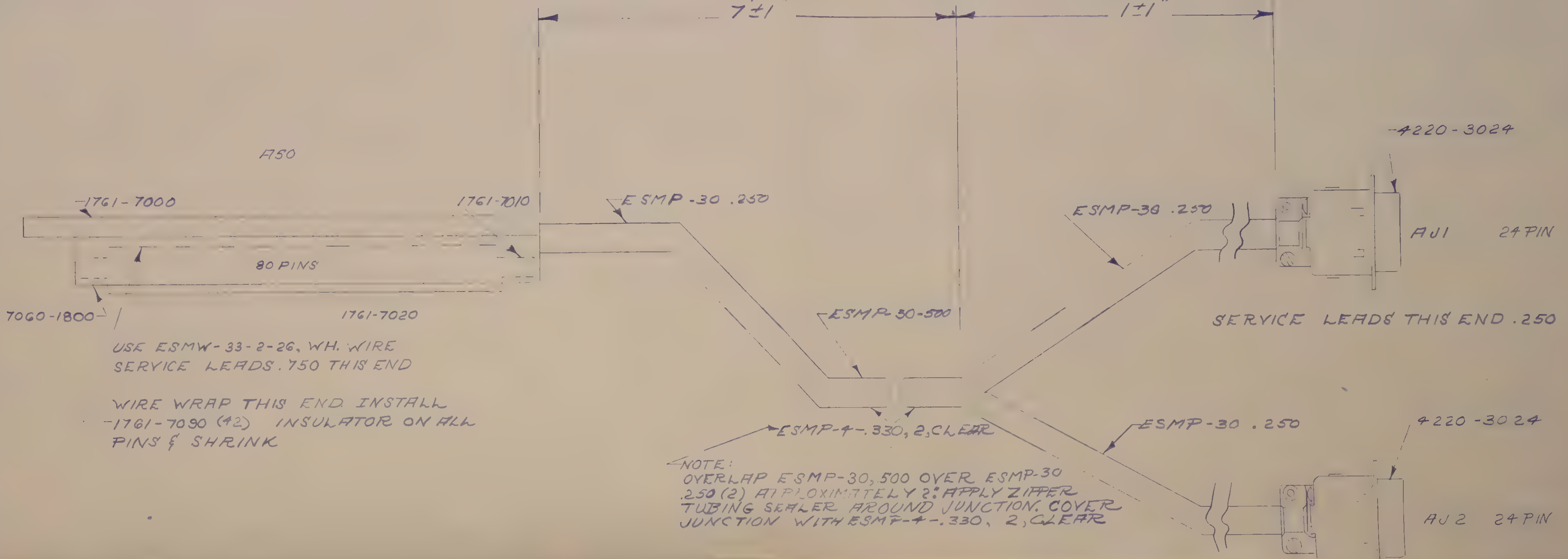
PIN	OTHER END
1	J7 [illegible]
2	J7 [illegible]

NUMBER 2994-1092 ISSUE [illegible]
DATE 3-25-69 ISSUE
REVISIONS

SCALE [illegible] FIRST USED ON
DR [illegible] CH. APP.

GENERAL RADIO COMPANY
W CONCORD, MASS. U.S.A.

NUMBER 2994-1092 ISSUE [illegible]


7±1"
1±1"
A50
1761-7000
1761-7010
80 PINS
7060-1800
1761-7020
ESMP-30 .250
ESMP-30 .250
ESMP-30-500
ESMP-4-.330, 2, CLEAR
ESMP-30 .250
4220-3024
AJ1 24 PIN
4220-3024
AJ2 24 PIN

USE ESMW-33-2-26, WH. WIRE
SERVICE LEADS .750 THIS END

WIRE WRAP THIS END. INSTALL
1761-7090 (42) INSULATOR ON ALL
PINS & SHRINK

SERVICE LEADS THIS END .250

NOTE:
OVERLAP ESMP-30, 500 OVER ESMP-30
.250 (2) APPROXIMATELY 2". APPLY ZIPPER
TUBING SEALER AROUND JUNCTION. COVER
JUNCTION WITH ESMP-4-.330, 2, CLEAR

SCANNER CONTROL INTERFACE CABLE ASM.
2994-1091

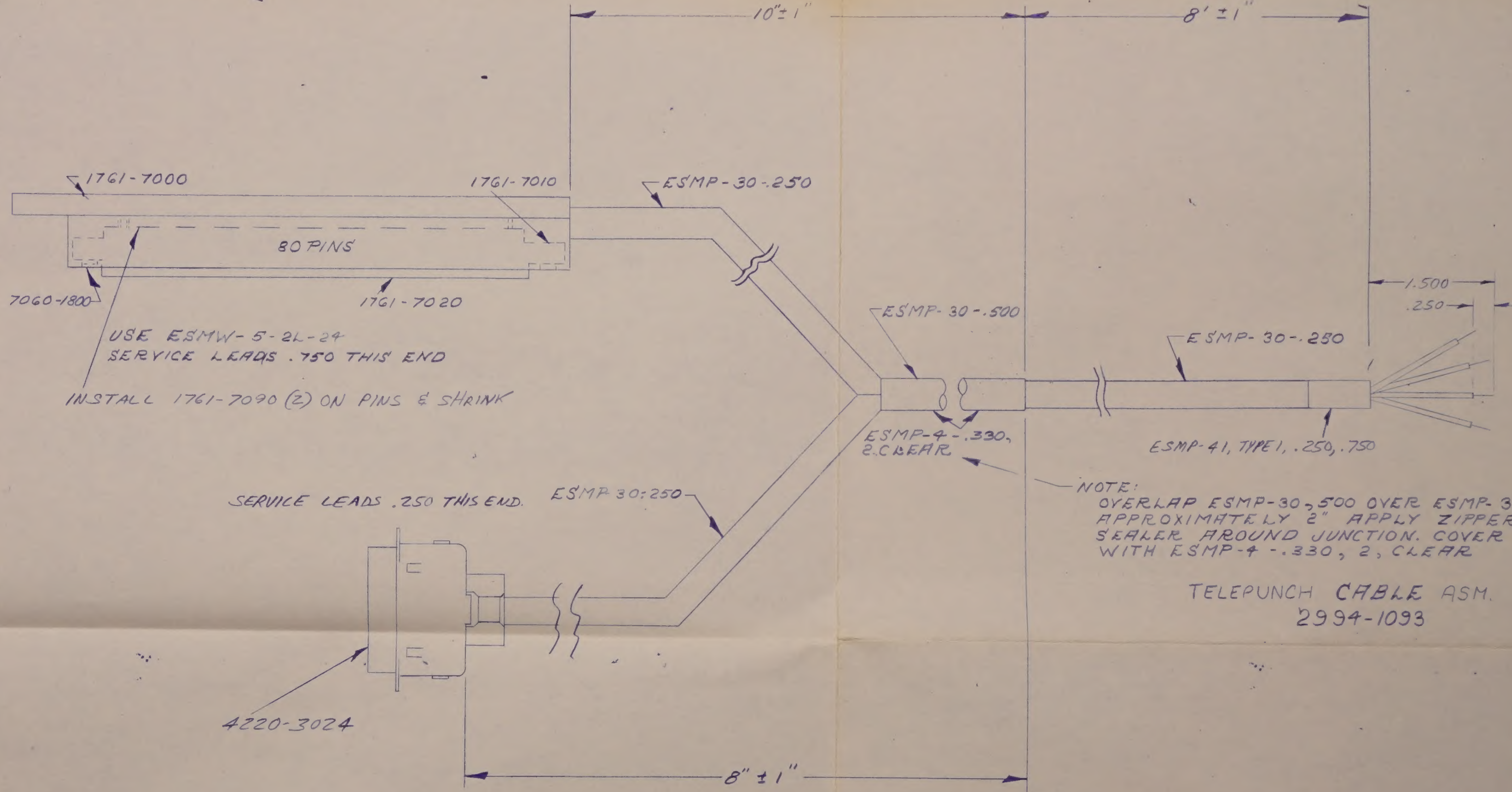
PIN A50	OTHER END	
1	AJ1	24
2	AJ2	24
8	AJ1	17
10	AJ1	19
20	AJ1	[illegible]
30	AJ2	17
49	AJ2	13
50	AJ2	14
52	AJ2	15
60	AJ1	12
66	AJ1	14
67	AJ1	13
68	AJ1	15
70	AJ1	11
72	AJ1	9
73	AJ1	1
74	AJ1	7
75	AJ2	1
76	AJ1	5
78	AJ1	2
79	AJ2	2

NUMBER 2994-1091	ISSUE 1
DATE 9-25-69	ISSUE 1
REVISIONS	

SCALE - FIRST USED ON
DR J.P. CH. APP

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1091 ISSUE 1


10" ± 1"
8' ± 1"
1761-7000
1761-7010
ESMP-30-.250
80 PINS
7060-1800
1761-7020
USE ESMW-5-2L-24
SERVICE LEADS .750 THIS END
INSTALL 1761-7090 (2) ON PINS & SHRINK
ESMP-30-.500
ESMP-30-.250
1.500
.250
ESMP-4-.330, 2,CLEAR
ESMP-41, TYPE 1, .250, .750
SERVICE LEADS .250 THIS END.
ESMP 30:250
4220-3024
8" ± 1"

NOTE:
OVERLAP ESMP-30,500 OVER ESMP-30.250(2) APPROXIMATELY 2" APPLY ZIPPER TUBING SEALER AROUND JUNCTION. COVER JUNCTION WITH ESMP-4-.330, 2, CLEAR

TELEPUNCH CABLE ASM.
2994-1093

1761 CONNECTOR	WIRE COLOR
PIN 6	BR
8	YE

4220-3024 CONNECTOR	WIRE COLOR
PIN 1	WH-YE-RD-BK
12	WH-YE-BR

NUMBER 2994-1093 ISSUE 1
DATE: 10-3-69 ISSUE 1

REVISIONS

SCALE FULL
FIRST USED ON 2990-9174
DR. JPJ
CH.
APP.

GENERAL RADIO COMPANY
W. CONCORD, MASS. U.S.A.

NUMBER 2994-1093 ISSUE 1